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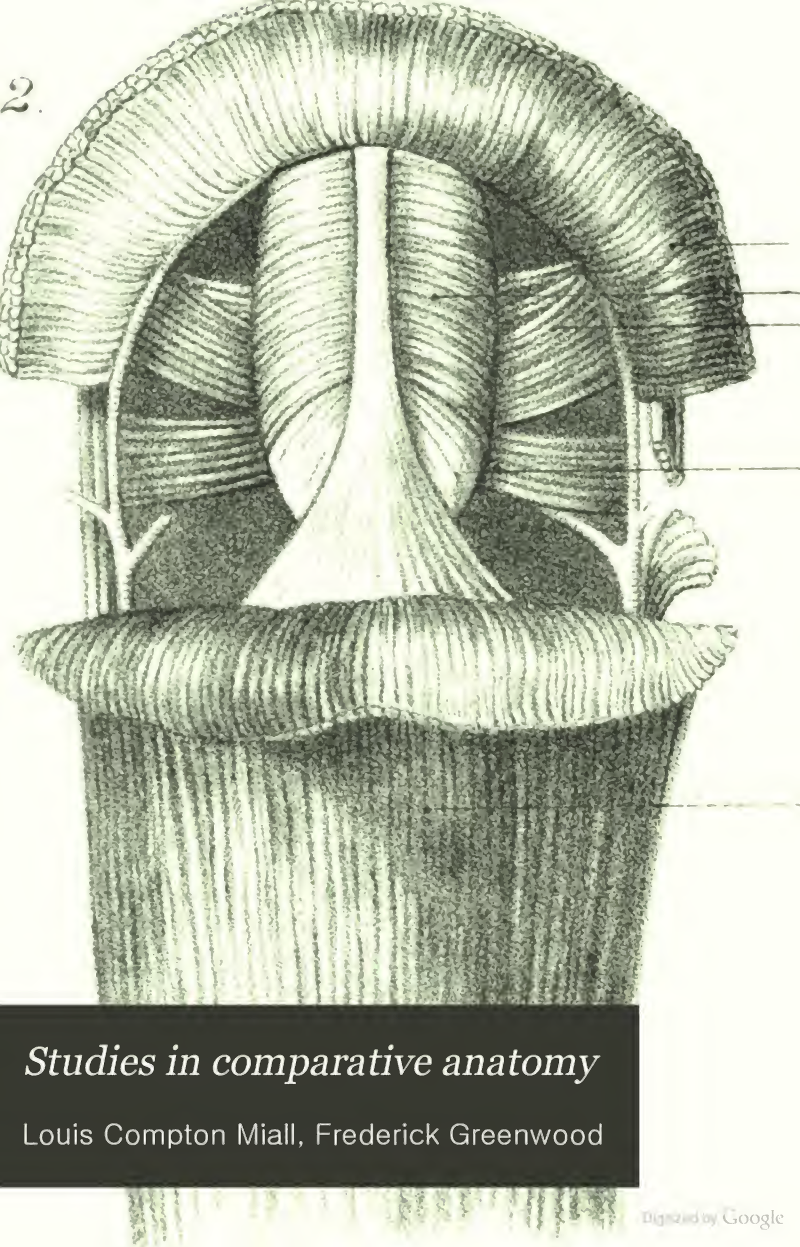

Studies in comparative anatomy

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ANATOMY OF THE INDIAN ELEPHANT

STUDIES IN COMPARATIVE ANATOMY.—No. II.

ANATOMY OF THE INDIAN ELEPHANT

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BIBL. PRINCETON.

London:
MACMILLAN AND CO.
1878

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INTRODUCTION.

WHENEVER the comparative anatomy of mammalia shall be exhaustively treated, the structure of the existing species of elephants will claim a principal share of attention. They are so distinctly separated from other quadrupeds that an order is required for their sole reception. Yet, though isolated from all other existing species, they bear marks of affinity with more than one group, particularly with Ungulata, Sirenia, and Rodentia. This fact of recent zoology suggests a view which the history of extinct mammalia seems to justify, viz., that the elephants constitute a comparatively primitive type, representing, though perhaps not directly, a now extinct central group, from which the orders above mentioned, and possibly some others, may have been derived. The African and Indian elephants are further remarkable as the largest land quadrupeds now living; nor can the palæontologist, reviewing the land quadrupeds of all past times, so far as they are yet made known, find a trace of any larger form which is not also an elephant. Hence arise some curious physiological and mechanical questions to the student of elephant anatomy. What are the special modifications implied by a weight of perhaps three tons? How nearly do the existing species approach the limits of size fixed by mechanical laws and by the physical properties of animal tissues?

It would be an interesting task to investigate such problems as these, and to discuss the many points of anatomy, morphology, physiology, and palæontology suggested by the examination of a dead elephant. Our immediate purpose is less ambitious. Leaving the greater enterprise to other times, and probably to other hands, we here offer a condensed statement of facts respecting those parts of the structure of the elephant which are at

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present least perfectly known. When the time for comparison and inference shall have come, such facts will be found of use.

For the convenience of future students, a list of the principal memoirs on the anatomy of the elephant is subjoined.[1] Some of these require special mention.

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[1] BLAIR, PATRICK.—The Anatomy and Osteology of an Elephant, being an exact Description of all the Bones of the Elephant which died near Dundee, April the 27th, 1706, with their several dimensions. *Phil. Trans.* vol. xxvii. p. 53, fig. (1710).

——— On the Organ of Hearing in the Elephant. *Phil. Trans.* xxx. p. 885, fig. (1718).

CAMPER, PIERRE.—Description Anatomique d'un Eléphant mâle. Publiée par son fils, A. G. Camper. Paris, fol. fig. (1802).

——— Kort berigt van de ontleding eens jongen elephants. Vaterlandsche letteroeffeningen (1774). Translated in Camper's *Kleinere Schriften*, pt. i. p. 51, and Œuvres, tom. i. and ii. p. 152.

CORSE, JOHN.—Observations on the Different Species of Asiatic Elephants and their Mode of Dentition. *Phil. Trans.* vol. lxxxix. pp. 205–236, fig. (1799).

CUVIER, GEORGES.—Recherches sur les Ossemens Fossiles. Paris, 4th ed. tom. i. pp. 468–582, fig. (1834).

CUVIER ET LAURILLARD.—Recueil de Planches de Myologie, tom. iii.

DAUBENTON.—In Buffon's *Histoire Naturelle*, vol. xi. Paris, 4to (1764).

GOODSIR, JOHN.—Notes on the Myology of the Elephant. Appendix to Anatomical Memoirs, vol. i. p. 446. Edinburgh, 8vo (1868).

HARRISON, ROBERT.—On the Anatomy of the Elephant. *Proc. Irish Acad.* vol. iii. pp. 385–398 (1847).

——— On the Larynx, Trachea, and Œsophagus of the Elephant. *Ib.* vol. iv. pp. 132–135 (1850).

——— On the Anatomy of the Lachrymal Apparatus of the Elephant. *Ib.* vol. iv. pp. 158–165 (1850).

HOME, EVERARD.—Some Observations on the Structure of the Teeth of Graminivorous Quadrupeds, particularly those of the Elephant and *Sus Æthiopicus*. *Phil. Trans.* vol. lxxxix. pp. 237–258, fig. (1799).

HOUEL, J. P. L. L.—Histoire Naturelle des deux Éléphans, mâle et femelle, du Muséum de Paris. Paris, 4to, fig. (1803).

[External parts only. These were the animals afterwards dissected by Cuvier.]

HUNTER, JOHN.—Essays and Observations, edited by Prof. Owen, vol. ii. pp. 170–176, London, 8vo (1861).

LEURET ET GRATIOLET.—Anatomie comparée du système nerveux. Paris, fol. fig. (1839–1857). [Brain.]

MAYER, C.—Beiträge zur Anatomie des Elephanten und der übrigen Pachydermen.—*Akad. Cæs. Leop.* vol. xxii. 4to, fig. (1847).

MOULINS, ALLEN.—Anatomical Account of an Elephant, accidentally burnt in Dublin, 4to, 72 pp. 2 pl. (1682).

OWEN, RICHARD.—Description of the Fœtal Membranes and Placenta of the Elephant (*Elephas Indicus*, Cuv.), with remarks on the value of placentary characters in the classification of the mammalia. *Phil. Trans.* cxlvii. pp. 347–353, pl. xvi. (1857).

Pierre Camper dissected an elephant in the winter of 1774. The work lasted less than three weeks. Camper had subsequently several opportunities of examining elephants of both sexes, and it was his intention to prepare a full anatomical description. He died, however, in 1789, leaving only the plates, an index to the figures, and the titles of the chapters which were to have composed the text. The published description, which is of some value, though by no means full, was drawn up by his son, A. G. Camper. The plates are free and tasteful, without much detail; they contain useful matter respecting the chief viscera, but only the most meagre notes of myology.

Hunter's notes are excellent, especially the account of the female generative organs.

Cuvier dissected a male elephant in 1805,[1] assisted by his pupils and by the painter Maréchal. He subsequently dissected two other specimens, a male and a female. The results appear in his posthumous *Recueil de Planches de Myologie*, published by Laurillard. The plates are not good. We find drawings only, without descriptive text, and the letters of designation are not always rightly affixed. Everywhere the want of the master's eye seems apparent. Though most of the details are correct, it is necessary to warn future students that hardly anything can be taken on trust from these plates. In the present memoir a systematic comparison with our own dissections has been made.

Mayer's dissection is given very briefly. Many of the muscles are merely named. We have found several mistakes of importance in this short account.

OWEN, R.—Odontography, pp. 625–655, pl. 146–150. London (1840–1845).

PERRAULT, CL.—*Mémoires de l'Académie Royale des Sciences*, tom. iii. part iii. p. 161, pl. xxiii. (1734).

——— Describes the African Elephant in *Mémoires pour servir à l'Histoire Naturelle des Animaux*, vol. ii. Amsterdam (1758).

SEBA, ALBERT.—Locupletissimi rerum naturalium Thesauri accurata descriptio, &c., vol. i. tab. iii. Amst. fol. (1734–1765). [Fœtus of Elephant.]

SERRAO.—Opuscoli di vario Argomento. Napoli, 4to, fig. (1766).

STUKELEY.—Essay towards the Anatomy of the Elephant (1723).

——— On the Spleen and Anatomy of an Elephant. London, fol. (1733).

SUPLY.—Remarques anatomiques sur un éléphant ouvert au fort Saint-Georges (1715).

TURNER, W.—Lectures on the Comparative Anatomy of the Placenta, 1st series, Edinburgh (1876). [Relates some Observations on the Structure of the Placenta in the Elephant.]

VULPIAN ET PHILIPPAUX.—Notes sur le cœur, le foie et les poumons d'un éléphant (femelle). *Ann. Sci. Nat. Zoologie*, vol. v. (1856).

WATSON, MORRISON, M.D.—Contributions to the Anatomy of the Indian Elephant. *Journal of Anatomy and Physiology*, 1871–74. Observations in Human and Comparative Anatomy. Edinburgh (1874).

ZIMMERMANN, E. A. W.—Beschreibung und Abbildung eines Neugebornen Elephanten. Erlangen, 4to (1783).

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[1] Deleuze, "History and Description of the Royal Museum of Natural History," *Eng. Trans.* vol. i. p. 91.

Vulpian and Philippaux give an excellent description of the heart, lungs, and liver. We have not thought it needful to describe these viscera afresh.

In 1856 the late Professor Goodsir purchased an Indian elephant, and dissected its fore and hind limbs, and the notes of his dissections, unfortunately very imperfect, are published in the Appendix to his *Anatomical Memoirs*, vol. i. p. 446. As the head and several of the viscera of this specimen had been preserved in spirit in the stores of the Anatomical Museum of the University of Edinburgh, Dr Morrison Watson was permitted by Professor Turner to examine them, and the results of his dissections were published in this *Journal*.

Our dissections, for the most part, agree closely with Dr Watson's, and had he been able to complete his researches in the same manner, our treatise would have proved superfluous.

A few words may usefully be said upon the mode of dissection. When this particularly awkward subject was offered to us we had no experience or instructions to guide us as to the best way of proceeding. We have, nevertheless, succeeded in preserving all the parts in a nearly unaltered state for three years without immersion in fluid. Any future dissector of a very large animal will do well to inject a preservative solution repeatedly before dismembering the carcase. Afterwards, it is merely necessary to keep the parts in a close-fitting box, lined with lead, and to wrap them in cloths wetted with dilute spirit, or other antiseptic. Occasional change of position is desirable.

Our example was a young female, about five feet high. It was purchased in December 1874 by the Council of the Leeds Philosophical and Literary Society, to whom our thanks are due, not only for permission to dissect the animal, but also for the readiness with which they have provided the appliances of all kinds necessary for such a piece of work.

MUSCLES OF THE FORE-LIMB.

Pectoralis major consists of two distinct portions. The superficial arises from the forepart of the sternum, and passes nearly transversely outwards, to be inserted about the middle of the shaft of the humerus. It is separated at its insertion by a small interval from the other part of the muscle. A few of the lowest fibres are continued into the fascia of the arm. *Pectoralis major* is overlaid by *masto-humeralis* and deltoid, with which some of its lower fibres are blended. The remaining portion of *pectoralis major* arises from the posterior two-thirds of the sternum, and passes forwards and outwards beneath the superficial part of the muscle, to be inserted into the humerus along the outer border of the bicipital groove, reaching upwards nearly to the apex of the greater tuberosity.

C. and L.[1]—274–5, *j*; 283, figs. 1, 2, j, j^1; 284, fig. 1, *j*, *j* (should be j_1); 285–6, j, j_1; 287–8, j, j_1; 292–3, j, j^2 (should be j_1).

Pectoralis minor.—Cuvier and Laurillard figure (292–3, j^3) a small muscle arising beneath the anterior portion of *pectoralis major*, and widening considerably towards its insertion into the upper end of the humerus. This is apparently the *pectoralis minor* of their index. We have not found this muscle.[2]

Serratus magnus arises by digitations from the 7th, 8th, 9th, and 10th ribs, and from the fascia above them. It is inserted into the inner surface of the apex of the scapula.

C. and L., 276-7 (*g*), 282, upper figure (*g*). Represented as arising from five posterior cervical vertebræ, as well as from ribs, 283, figs. 1, 2 (*g*).

Masto-humeralis arises by two distinct heads, the larger of which is attached by a strong rounded tendon to the basilar process of the occipital bone. The second and thinner head arises by a flat tendon from the mastoid process between the stylo-mastoid foramen and the origin of *digastricus*. It is inserted into the top and outer side of the tuberosity of the humerus, blending with the anterior part of the deltoid.

C. and L.—274–5 (b^1), "cleido-mastoidien ou trachélien;" 276–7 (b^1); 287–8 (b^1) (incorrectly shown as inserted into the first rib); 290–1 (b^1), 292–3 (b^1).

The plates indicate an insertion much lower down upon the humerus than that given above. We cannot reconcile the relations of b^1 to *k* (*masto-humeralis* to deltoid) in the different plates.

Deltoideus is comparatively thin. It arises from the under surface of a strong fascia, which is attached to the spine of the scapula, and stretches over the shoulder-joint. Part of the muscular fibres pass back to the angle formed by the spine and the unciform process. The remaining fibres arise from the fascia, along a line which extends from the tip of the unciform process to the posterior border of the scapula. The fascia is continued upwards and backwards over the *infraspinatus* to the borders of the fossa. The deltoid passes downwards, winding over the tuberosity of the humerus, and is inserted into the outer and anterior surface of the humerus, immediately below the root of the tuberosity. Some of its fibres run into the *teres minor, q.v.*

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[1] Cuvier and Laurillard, *Recueil de Planches de Myologie.*

[2] Our notes of the sterno-humeral muscles are, unfortunately, not quite complete, and certain details cannot now be recovered. The parts were cut through, when little beyond a *post-mortem* examination was thought possible.

C. and L.—274–5, k^1 (we have found nothing exactly corresponding to k); 276–7 (k^1); 283, fig. 1 (k?); 284, fig. 1 (k^1); 292–3 (k?).

Subscapularis arises from the whole internal surface of the scapula, except at the angles. *Serratus magnus* is inserted into the superior angle; *teres major* arises from the inferior angle; while above the glenoid cavity is a surface unoccupied by muscle, over which the *subscapularis* plays. This muscle takes origin also from the suprascapular ligament. It is inserted by a thin flat tendon into the internal surface of the head of the humerus close to the articulation. The insertion is overlaid by the *coraco-brachialis.*

C. and L.—283, figs. 1, 2 (*n*); 284, fig. 1 (*n*).

Supraspinatus.—A thick muscular mass, filling the supraspinous fossa, and taking origin also above from the fascia which covers the muscle. Inserted into the upper border of the tuberosity of the humerus. Fleshy throughout.

C. and L.—276–7; 283, figs. 1, 2; 284, fig. 1 (*l*).

Infraspinatus arises from the posterior surface of the spine of the scapula, and from the under surface of the unciform process. Its origin from the bone is defined below by a line drawn from the tuberosity of the humerus to the junction of the upper and middle thirds of the posterior border of the scapula. It arises also from the intermuscular septum between it and *teres minor,* and from the fascia which covers in the infraspinous fossa above the level of the unciform process. The muscle converges to a strong flat tendon, which is inserted into an oblique line along the outer surface of the base of the tuberosity of the humerus. Above this line a large and distinct bursa separates it from the tuberosity.

C. and L., 276–7 (*m*).

Teres minor arises from the outer surface of the scapula along the middle third of the posterior margin, and from the intermuscular septum beneath the muscle. It is inserted into the neck of the humerus behind and below *infraspinatus,* with the lower border of which some of its fibres are connected. Its tendon is also closely connected with a very strong bundle of ligamentous fibres from the deep surface of the deltoid.

C. and L., 276–7 (*o*, the letter indicates *teres major*, according to the index).

Teres major arises from a small triangular surface on the internal aspect of the inferior angle of the scapula. It is inserted into the neck of the humerus along about two inches of a line connecting the inner side of the head of the humerus with the internal condyle. The lower fibres of the tendon are connected with part of *coraco-brachialis.* Immediately behind it is a bundle of muscular fibres, forming part of the *triceps.* The tendon of *teres major* is embraced by the two portions of the tendon of *latissimus dorsi,* of which the more superficial is inserted into the humerus a little above *teres major,* while the deeper and smaller portion is inserted immediately behind it.

C. and L.—283, figs. 1, 2 (*o*). In the second figure the origin would agree better with that of *teres minor.*

Coraco-brachialis arises thin and flat, by tendinous fibres from the tip of the coracoid tubercle, and from the upper part of the capsule of the shoulder-joint, It is inserted by fleshy fibres into the anterior surface of the humerus, between the insertion of *latissimus dorsi* and the internal condyle.

C. and L.—283, figs. 1, 2; 284, fig. 1 (*q*).

Biceps arises within the capsule of the shoulder-joint, from which it emerges as a strong round tendon. There is no trace of a coracoid head. The muscle gradually increases in thickness to the elbow-joint. Some of the deeper fibres are inserted into the anterior part of the capsular ligament, the rest pass over the joint to be inserted into the front and inner side of the ulna, close to its upper extremity. A large vein separates the insertion of the *biceps* from *brachialis anticus.*

C. and L.—283, figs. 1, 2 (*r*); 284, fig. 1 (r^1). The drawings are correct; but the index mentions a coracoid head which does not exist.

Brachialis anticus arises from the humerus just below the articular end, and external to the greater tuberosity. The muscle winds round the shaft of the bone to reach the front of the external condyloid ridge, from the commencement of which it receives some of its lower fibres. Inserted into the front of the ulna, immediately below the *biceps*. The musculo-spiral nerve lies along its posterior border, while the *extensor carpi radialis longior* crosses it superficially. Beneath it lies a plexus of large veins, just above the elbow-joint, and a large horizontal branch of the brachial artery.

C. and L.—276–7 (*s*), 283, figs. 1, 2 (*s*); 284, figs. 1, 2 (*s*)?

Triceps.—The middle or long head (C. and L., 274–5, *t*, 276–7 *t*, 283 figs. 1, 2, t^2, origin only 284 fig. 1 t^1?), arises from the whole axillary border of the scapula by a thick and strong fleshy mass. It expands as it passes down, blends towards the elbow with the external head, and is inserted with it into the posterior surface of the end of the olecranon, lying superficially to the remainder of the muscle, from which it is separated indistinctly by connective tissue. The external head (C. and L., 274–5, t^1, 276–7, t^1), the stronger of the remaining two, arises from the posterior surface of the humerus, reaching as high as the greater tuberosity. It bridges over the musculo-spiral nerve just above the external condyloid ridge, and blends with the deeper surface of the middle head. The inner head (C. and L., 283, fig. 1, t^3, 283, fig. 2, *t*) has a small pointed origin close below the insertion of *latissimus dorsi*. It passes downwards and widens out so as to occupy the whole posterior surface of the bone, between the condyloid ridges, a strong bundle taking origin from the external condyloid ridge. The inner head is inserted anterior to the rest of the muscle into the olecranon process.

Dorso-epitrochlearis.—A thin and flat muscle, which arises close to the posterior angle of the scapula on its ventral surface, and from aponeurotic fibres superficial to *triceps*. The lower part of the muscle is connected, close to its origin, with strong aponeurotic fibres derived partly from *latissimus dorsi*, partly from *panniculus*, and passing into the posterior border of the middle head of *triceps*. *Dorso-epitrochlearis* passes down as a thin flat muscle, extensively tendinous on its deeper surface, and is inserted by a small rounded tendon into the olecranon on its inner side, close to *triceps*, with which it partly blends.

C. and L., 283, fig. 1 (*t*), fig. 2 (*t* †).

Pronator radii teres.—A strong ligament, which may represent this muscle, springs from the inner side of the internal condyle of the humerus, about on a level with *flexor carpi radialis*, but anterior to it. This ligament passes obliquely over the muscles and vessels, and is inserted into the middle of the radius for about two inches, expanding greatly over the bone. Beneath it, towards the radial extremity, are some muscular fibres, which spread out towards their insertion as a small triangular muscle, continuous with the ligament, and covered by it superficially.

C. and L., 283, figs. 1, 2 (*x*).

Flexor carpi radialis arises by a flat tendon from the back of the internal condyle of the humerus, passes directly along the inner side of the fore-arm, and ends in a round tendon, which occupies a distinct sheath connected with the annular ligament. The tendon is finally inserted rather deeply into the carpus. This muscle is remarkably elastic. When cut, it is retracted 3 inches, and is seen to be composed of regular alternate layers of muscular and elastic fibres in about equal proportions. The muscular fibres predominate towards the deeper surface, and also towards the origin of the muscle. This unexpected structural peculiarity would give rigidity to the limb, when it is extended in a perfectly straight line. When the animal stands, the toes are, so to speak, over-extended, so that the *flexor carpi radialis*, stretched like the chord across an arc, tends to draw the carpus upwards and forwards, and opposes the flexors. When, on the other hand, flexion has carried the limb in the least beyond the neutral line, the elastic band assists the flexors, drawing the carpus upwards and backwards.

C. and L.—283, figs. 1, 2 (γ); 284, fig. 2 (γ).

Elastic ligament of outer side of fore-arm.—Connected with the external condyle of the humerus is a very strong flattened band, composed partly of yellow elastic, but chiefly of white fibrous tissue. This passes down along the outer side of the fore-arm, and blends on its anterior and posterior borders with the strong fascia of that part of the limb. Opposite the upper fourth of the bones of the fore-arm, this ligamentous band spreads out laterally, becomes greatly thickened, and is converted almost wholly into yellow elastic tissue. It continues to widen as far as 2 inches above the lower end of the ulna, where it divides into two portions; of which the anterior and stronger is inserted into the front of the end of the ulna, the posterior into the outer surface of the end of the same bone. The tendon of *extensor minimi digiti* separates the two portions. The insertion consists of white fibres chiefly.

Palmaris longus arises from the back of the internal condyle of the humerus, and from the strong intermuscular septa which divide it on the radial side from *flexor communis digitorum,* and on the ulnar side from *flexor carpi ulnaris. Palmaris* is a flat muscle, becoming tendinous at the commencement of the carpus, where it spreads out over the palm. The strongest portion of the tendon passes to the ulnar side, and is inserted into the sesamoid bone of the 5th digit. A median portion is much slighter, and is lost in the palm. On the radial side, part of the expansion blends with that of the extensor tendon. Lastly, a strong tendinous bundle of *palmaris* is attached by its deep surface to the annular ligament, nearly over the tendon of *flexor carpi radialis,* and superficial to the origin of *flexor brevis.*

C. and L.—283, figs. 1, 2 (*a*); 284, fig. 2 (*a*).

Flexor carpi ulnaris arises by two heads, one, thin and pointed, from the internal condyle, the common aponeurosis, and extensively from the intermuscular septum between this muscle and *flexor communis digitorum.* The second head, on the ulnar side, arises thick and fleshy from the back and inner side of the olecranon, immediately below the insertion of *triceps.* The ulnar nerve passes between the two heads of origin. The united muscle is inserted into the pisiform bone, and continued thence by strong fibres to the ulnar side of the manus.

C. and L.—274–5 (β); 276–7 (β); 283, figs. 1, 2 (β); 284, figs. 2, 4 (β).

Flexor communis digitorum arises by a common tendon with *palmaris* and *flexor carpi ulnaris* from the back of the internal condyle of the humerus. Its deep surface is tendinous, and separated by loose cellular tissue from the bones of the fore-arm. It ends in a very strong, flat tendon, which divides into five opposite the base of the radial sesamoid bone. Of these tendons, those to the 1st and 5th digits are only half the size of any of the others. The middle tendon is rather the strongest of the remaining three. Inserted as usual into the terminal phalanges. A small muscle, which may correspond to *flexor longus pollicis,* arises, close to the common tendon, from the internal condyle of the humerus, but somewhat deeper. It lies beneath *flexor communis digitorum*, and to its radial side. At the lower fourth of the fore-arm it ends in a round tendon, which joins the deep surface of the common flexor. Another muscle arises by fleshy fibres from the ulna, beneath the ulnar origin of *flexor carpi ulnaris*, and to its inner side. It consists of a small conical bundle of muscular fibres, ending in a thin round tendon near the upper extremity of the fore-arm. The tendon joins the deep surface of the tendon of the common flexor on its ulnar side.

C. and L.—283, fig. 2 (μ, μ^1); 284, fig. 2 (μ^1, μ, the letters of the preceding figure are reversed here, μ^2), fig. 4 (μ).

Flexor brevis digitorum arises from the annular ligament of the wrist, where it forms a sheath for *flexor carpi radialis.* It consists mainly of fleshy fibres. Opposite the base of the radial sesamoid it divides into two nearly equal masses, of which that to the radial side is inserted into the sheath of the long flexor tendon of the 4th digit. The short flexor crosses the other superficially, and is attached to its ulnar side. The second mass, shorter and smaller than the other, is similarly inserted into the flexor tendon of the 5th digit, blending also with the palmar fascia at its attachment to the sesamoid bone of the 5th digit.

C. and L.—283, fig. 2 (ξ); 284, figs. 2. 3, 4 (ξ).

Extensor carpi radialis longior (*supinator longus?*) arises chiefly from the lower part of the tendon of insertion of the deltoid on its outer side. It extends a little further upwards, and is connected with the lower and anterior border of the external head of the *triceps.* Between these points a thin slip arises from the humerus. The muscle passes down in its usual position, bridging over the *brachialis anticus.* It ends at the lower third of the fore-arm in a small tendon, which passes together with *extensor carpi radialis* beneath *extensor proprius pollicis,* then through a sheath upon the radius, having a separate compartment, but lying in the same groove with *extensor carpi radialis.* It lies rather deeper than that muscle, and to its inner side. It is inserted into the semilunar bone of the carpus.

C. and L.—274–5 (δ); 276–7 (δ); 283, figs. 1,2 (δ); 284, fig. 1 (δ).

Extensor carpi radialis brevior arises from the front of the external condyloid ridge. It ends in a strong tendon which passes beneath *extensor pollicis,* and has a distinct sheath upon the lower end of the radius; crosses the carpus, and is inserted principally into the base of the metacarpal of the 3d digit, and partly into the metacarpal of the 2d.

C. and L.—274–5 (δ^1); 276–7 (δ^1); 283, figs. 1, 2 (δ^1); 284, fig. 1 (δ^1).

Extensor communis digitorum arises by fleshy and tendinous fibres from the lower part of the external condyloid ridge, on the outer side of *extensor carpi radialis,* and also from the outer side of the external condyle, the two portions being indistinctly separated by a septum. The muscle passes down in a special sheath over the end of the radius, and becomes tendinous opposite the wrist-joint. The tendon spreads over the carpus, and is finally inserted into the upper surface of the 2d, 3d, 4th, and 5th digits. The divisions of the tendon of insertion form arches beneath which the vessels appear, as in the pes.

C. and L.—274–5 (ϵ); 276–7 (ϵ); 284, fig. 1 (ϵ).

Extensor minimi digiti arises by two heads—one muscular, and the stronger of the two, from the outer surface of the external condyle; the other, which is smaller and tendinous, from the front and outer side of the head and shaft of the ulna, and from an intermuscular septum between it and *extensor carpi ulnaris.* The muscle passes through a distinct sheath on the back of the ulna to the outer side of the manus, crossing the insertion of *extensor carpi ulnaris,* and is inserted into the base of the 5th digit. A tendinous expansion passes from the forepart of the tendon to the outer side of the base of the 1st phalanx of the 4th digit, and blends with the deep surface of *extensor communis.*

C. and L.—274–5 (ϵ^1); 276–7 (ϵ^1); 284, fig. 1 (ϵ^1). The additional slip of insertion is shown as passing to the 3d and not to the 4th digit.

Extensor carpi ulnaris, a strong muscle arising by a round tendon from the external condyle of the humerus, behind and a little above *extensor minimi digiti.* It lies along the outer surface of the ulna, passes through a distinct sheath on the outer side of the lower extremity of that bone, and is inserted by a strong round tendon into the metacarpal of the 5th digit.

C. and L.—274–5; 276–7; 284, fig. 2 (β^1).

Anconæus arises chiefly from the back of the external condyloid ridge; some of the upper fibres taking origin from the posterior border of the elastic ligament of the fore-arm, and some of the deeper fibres from the superior tendon of *extensor carpi ulnaris.* From this origin the muscle spreads out, and is inserted into a triangular surface on the outer side of the ulna, immediately beneath the olecranon. The apex of this triangle is situated nearly half way down the shaft. Below, the muscle is overlaid by *extensor carpi ulnaris,* and above by a dense fascia.

C. and L.—274–5; 276–7; 283, fig. 2; 284, fig. 2 (*u*).

Extensor pollicis arises from nearly the whole anterior surface of the radius, with the exception of a small part towards the lower end of the bone, from the interosseous membrane and from the adjacent surface of the ulna. At the lower part of the radius the muscle is twisted upon itself, so that the external fibres become anterior, and ultimately internal. The tendon passes through a special sheath on the inner side of the end of the radius, and is inserted into the base of the 1st digit. The tendon is connected by a lateral expansion with that of the *extensor indicis.* A large vein and the posterior interosseous nerve pass between the radial and ulnar origins of the muscle. Several large veins, communicating with the plexus in front of the elbow-joint, lie in the interosseous space beneath the muscle.

C. and L.—274–5; 276–7; 283, figs. 1, 2; 284, fig. 1 (ι).

Extensor indicis.—Small and pointed above, where it arises from the front of the ulna close to the head of the radius, and below this from the intermuscular septum on the outer side between it and *extensor minimi digiti,* and on the inner side between it and *extensor pollicis.* The *extensor indicis* passes over the wrist in a separate synovial sheath, but in the same groove with *extensor communis digitorum,* and to its inner side. The tendon passes obliquely to the inner side of the manus, crossing the tendon of *extensor carpi radialis.* It then spreads out, and is inserted into the inner (radial) side and front surface of the 1st phalanx of the 2d digit. An expansion connects this tendon with that of *extensor pollicis,* close to their insertion.

C. and L.—274-5; 276–7; 284, fig. 1 (ϵ^2). Shown as connected with the inner side of the tendon of *extensor communis digitorum,* not with *extensor pollicis.*

Abductor minimi digiti arises from the annular ligament and pisiform bone. It is inserted into the sesamoid bone of the 5th digit to the ulnar side of *flexor brevis digitorum.*

C. and L.—283, fig. 2; 284, figs. 2, 3, 4 (*v*). In 283, fig. 2, a small muscle ("abductor"—adductor?—"minimi digiti") is shown internal to the short flexor of the toes. We have not found this.

The *palmar fascia* consists of strong fibrous bands crossing in various directions, with large intermediate spaces filled with fat, especially between the digits. An exceedingly strong semicircular band, concave towards the wrist, stretches across the heads of the metacarpal bones, and forms sheaths in the usual way for the flexor tendons. By dissection these sheaths can be resolved into a superficial or proper transverse ligament, and a deeper layer, which, when divided, presents on its deep surface two tendinous slips passing to be inserted into the base of the second phalanx on each side of the flexor tendon. This disposition resembles the ordinary arrangement of the *flexor sublimis.*

C. and L., 284, fig. 3.

Lumbricales arise all together from the superficial surface of the flexor tendon, just above its division. They are four in number, of which the 1st and 2d (from the radial side) are respectively inserted into the bases of the 1st and 2d digits on the ulnar side. The 3d lumbrical is inserted into the deep side of the sheath of the flexor of the 3d digit, and is continuous with one of the lateral tendinous bands of the flexor sheath. The 4th lumbrical passes deeply between the 3d and 4th digits, and is connected with an aponeurosis from the extensor tendon. The 1st and 2d *lumbricales* appear to have a similar attachment on the extensor side of the manus.

C. and L.—284, fig. 4. The 1st lumbrical is not seen in this drawing.

Flexor brevis pollicis.—The only short muscle of the first digit. Arises by a pointed origin from the os magnum, and is inserted into the sesamoid bone on the head of the first metacarpal. This muscle corresponds most nearly with the inner head of *flexor brevis pollicis.*

Not in C. and L.

Flexor brevis minimi digiti consists of two slips, which arise from the unciform bone, and from a ligamentous band uniting the unciform and pisiform bones. The slips run side by side to their insertion into the ulnar side of the sesamoid on the head of the fifth metacarpal.

Not in C. and L.

Opponens minimi digiti arises from a prominence upon the unciform bone, opposite the articulation of the fourth metacarpal, and is inserted into the radial side of the sesamoid of the fifth digit.

Not in C. and L.

Interossei (manus).—There are three palmar *interossei*, which arise near together from the carpus, opposite the articulation of the third metacarpal. They diverge to be inserted—the first into the expansion of the *extensor communis digitorum* on the ulnar side of the second digit; the other two in the same manner, but on the radial sides of the fourth and fifth digits. The insertion corresponds, therefore, with that in the human subject. The dorsal *interossei* are also three in number, and form short, thick muscles. That of the index digit consists of two distinct portions, one arising from the base of the first metacarpal and the adjacent surface of the trapezium; the other from the base of the second metacarpal. They are inserted together into the sesamoid of the index. The *interosseus* of the third digit arises from the base of the third metacarpal, and is inserted like the preceding. The *interosseus* of the fourth digit is quite similar to that of the third. Each of the dorsal *interossei* shows a distinct separation into lateral halves, one to each division of the sesamoid. The *interossei* are invisible from the dorsal side of the manus.

Not in C. and L.

Of the foot as a whole, and this remark applies to both fore and hind extremities, the separate mobility of the parts is greater than would be suspected from an external inspection, and much greater than in most Ungulates. The palmar and plantar soles, though thick and tough, are not rigid boxes like hoofs, but may be made to bend even by human fingers. The large development of muscles acting upon the carpus and tarsus, and the separate existence of flexors and extensors of individual digits, is further proof that the elephant's foot is far from being a solid, unalterable mass. There are, as has been pointed out, tendinous or ligamentous attachments which restrain the independent action of some of these muscles; but anatomical examination would lead us to suppose that the living animal could, at all events, accurately direct any part of the circumference of the foot by itself to the ground.

The metacarpal and metatarsal bones form a considerable angle with the surface of the sole; while the digits, when supporting the weight of the body, are nearly horizontal.

MUSCLES OF THE HIND LIMB.

Psoas magnus arises chiefly from the sides of the bodies of the four lower dorsal vertebræ. It receives slips from the 15th, 16th, 17th, 18th, and 19th ribs. Inserted, together with *iliacus*, into the inner side of the femur below the neck of the bone. Another slip arises from the brim of the pelvis and the capsular ligament, passing to the front of the femur, 3 inches below the capsular ligament.

C. and L., 290–1, *h*.

Psoas parvus arises from the sides of the bodies of the lumbar vertebræ, internal to *psoas magnus*. It ends in a tendon about 4 inches long, which is inserted into the brim of the pelvis for about the middle third of the lateral margin. The external iliac vessels lie adjacent to the inner side of this muscle.

C. and L., 290–1, *g*.

Iliacus arises from the whole of the iliac fossa, except a small space adjacent to the brim of the pelvis, over which *psoas magnus* passes. It is inserted together with that muscle. The anterior crural nerve emerges between *psoas* and *iliacus* in the usual position.

C. and L.—290–1, *i*; 292–3, *i*; 294, fig. 1, *i*. In 290–1 the muscle is shown as a rounded tapering mass, lying upon the inferior surface of the ilium, and projecting considerably from it. The full width of the muscle (which occupies the whole of the ilium) and its conformity to the curves of the iliac fossa do not appear in the drawing.

Tensor fasciæ femoris, a thick strong muscle, arises from the outer surface of the anterior spine of the ilium, and from the bone immediately adjacent. It passes downwards on the outer side of the thigh, and is lost in the fascia at the junction of the lower third with the remainder of the thigh. Here it is closely united with the anterior fibres of *glutæus maximus.*

C. and L.—274–5 *x*, 276–7, 287–8, 290–1, 292–3; 294, fig. 1 *x*. Omitted by Mayer.

Gracilis arises by a very thin flat tendon from the posterior three-fourths of the middle line of the pubic symphysis. The tendon has a straight anterior border, and terminates about halfway between the origin and insertion, where muscular fibres take its place. On the posterior border the muscular fibres run up to the origin. Most of the fibres pass backwards and downwards, and are inserted into the fascia of the thigh. The anterior fibres, which form a separable band about two inches wide, are inserted into the inner side of the tibia, an inch and a half below the tuberosity.

C. and L.—285–6 *u*. In this drawing the posterior margin is too distinct, and the muscle far too rounded and solid. 290–1; 292–3; 294, fig. 2 *u*.

Sartorius.—A broad, flat muscle, which arises from the fascia on the front and inner part of the thigh below Poupart's ligament. The muscle consists of loosely coherent muscular bundles which thin out below. The most prolonged are inserted by several tendinous strings into the thick yellow fascia of the leg immediately below the knee-joint on its inner side.

Not figured by Cuvier and Laurillard.

Glutæus maximus occupies, superficially, the inner two-thirds of the buttock. It is sheathed in fascia, which, on the outer side of the muscle, is strengthened by a considerable thickness of yellow elastic tissue, but thins away internally. The muscle arises from the crest of the ilium by means of a thin fascia, from the dense fascia which covers *glutæus medius,* from the side of the sacrum and upper caudal vertebrae, and from the great sacro-sciatic ligament. The fibres are inserted as follows:—The anterior or external part into the upper part of the fascia lata, the internal fibres into the inner edge of the same, while a strong bundle of the deep inner fibres passes to the middle fifth of the femur.

C. and L.—274–5; 276–7; 287–8; 294, fig. 2 (*a*, *q* part).

We cannot understand Pl. 294, fig. 2. The foreshortening is probably wrong. What are described above as the internal fibres of *glutæus maximus,* Cuvier and Laurillard call *biceps,* while the deep inner fibres correspond to their "*biceps*—portion fémorale." Mayer assigns to *glutæus maximus* an insertion into the great trochanter; he speaks further of its tendon as blending with a portion of the "caput breve des M. occipitis."

Glutæus medius arises from the side of the upper part of the sacrum beneath *glutæus maximus,* from the upper half of the back of the ilium, from the dense fascia covering the muscle, and from the lower and anterior part of the crest of the ilium as far as the anterior spine. It is separated from *glutæus minimus* by vessels, and the superior gluteal nerve. From this origin the fibres converge and are inserted as follows:—The anterior two-thirds into a line which extends obliquely downwards and forwards from the superior and posterior part of the great trochanter, the posterior third into the apex of the trochanter and into a ligament which passes thence to the acetabulum. The most posterior fibres pass down to the posterior root of the trochanter about 8 inches from its apex.

C. and L.—276–7; 287–8; 294 (a^1).

Glutæus minimus arises from the middle third of the back of the ilium beneath *glutæus medius.* The fibres converge to a small tendon which is inserted into a depression on the outer aspect of the root of the trochanter.

C. and L.—287–8 (a_2); 294, fig. 1 (a_2). The *f* of the last-mentioned figures, "pyramidal (sacro-trochantérien)," we have not found as a separate muscle. In the absence of a_2 this would agree with our *G. minimus.*

Biceps femoris arises by a thin round tendon from the tuberosity of the ischium beneath and external to the other hamstring muscles. It is narrow above, but widens greatly below. The more anterior fibres are continuous with the lower fibres of *glutæus maximus,* and are inserted into the outer side of the femur for several inches above the knee. A separable strap-like bundle of the most posterior fibres proceeds from the belly of the biceps to the fascia of the leg. The peroneal nerve separates the anterior from the posterior division of the muscle.

C. and L. (biceps—portion fémorale).—274–5; 276–7; 287–8;

294, fig. 2 (part of *q*, and in 294, fig. 2 *q*). The biceps of Cuvier and Laurillard includes also what we have described as the posterior part of *glutæus maximus.*

A strong band of fascia is continued from the back of the leg to the calcaneum; *biceps* passes into the oblique upper edge of this fascia, and the tendon of *gastrocnemius externus* blends with its deep surface.

Semitendinosus arises by fleshy fibres from the ramus of the ischium, and ends about the middle of the thigh in a thin tendon, which is lost in the fascia of the inner and back part of the thigh.

C. and L.—274–5; 285–6; 287–8; 289, figs. 1, 3, 4; 294 (*r*). Drawn as passing to the inner side of the tibia, and ending in a distinct tendon.

Semi-membranosus arises by a double tendon. The external head, long, round, and slender, is attached to the great sacrosciatic ligament and the side of the sacrum. The other, square in section, and tendinous upon its deep surface, springs from the tuberosity of the ischium. The muscle ends in a flattened tendon about three inches below the knee-joint. This tendon divides into two parts, of which the anterior, broad and flat, is inserted into the anterior and internal surface of the tibia, about the middle of the bone; the posterior portion is continued to the internal malleolus, and is connected along its posterior border with the deep fascia of the leg.

C. and L.—274-5; 285–6; 287–8; 289, fig. 4; 294 (*s*).

Obturator externus arises from the outer surface of the obturator membrane, and from the bone beneath. It is inserted into the digital fossa of the femur, anterior to *obturator internus,* and somewhat below it.

Not given in Cuvier and Laurillard.

Obturator internus arises from the inner margin of the obturator foramen, and is inserted into the digital fossa, posterior to *obturator externus,* and by a narrower tendon.

Not given in Cuvier and Laurillard.

Adductor magnus takes origin from the os pubis and ramus of the ischium. It is inserted into the back and inner side of the femur for about the middle two-thirds of its length, and by a separate slip into the internal condyle of the same bone.

Adductor magnus is pierced, as usual, by the femoral vessels, which intervene between the main part of the muscle and the slip which passes to the internal condyle. It is pierced also by the obturator nerve.

C. and L.—285-6 (*l*); 289, figs. 3, 4 (*l*); 290-1 (*l*, l^1); 292-3 (*l*).

Adductor longus is closely connected above with *pectineus*, but has a distinct rounded tendon of origin, attached to the front of the pubes beneath *pectineus*, and nearer to the symphysis. *Adductor longus* is inserted into the inner side of the femur, reaching to a point just above the internal condyle.

C. and L.—("2e Pectiné"), 290-1; 292-3 (k^1).

Adductor minimus.—This large and distinct quadrilateral muscle arises from the ramus of the ischium, beneath the hamstring muscles, and is inserted into the posterior surface of the femur for about the second fourth of the bone, counting from above. Towards its insertion it is partly enveloped by *adductor magnus*, a large vein separating the two muscles. Their fibres ultimately unite, and are inserted together.

C. and L., 290-1 (*d* ?).

Pectineus takes origin between the iliopectineal eminence and the symphysis pubis. Some of its fibres are closely connected with the tendon of origin of *adductor longus*. It is inserted into the middle of the femur on its inner side, above and external to *adductor longus*.

C. and L.—285-6; 290-1; 292-3 (*k*).

Gastrocnemius externus arises by a small round tendon from the external condyle of the femur in front of *plantaris* and external to it; also from the intermuscular septum between it and the *peronæi*. It is a thin, flat muscle, ending by a tendon in the deep surface of the common tendon of the os calcis.

C. and L.—("Plantaire grêle"), 276-7, 285-6, 287-8, 289, figs. 3, 4 (γ). Mayer's figure of the *gastrocnemii* (*Act. Acad. Cæs. Leop.* vol. xxii. t. ix. fig. 4), is very indistinct and not accurate.

Gastrocnemius internus takes origin as a thin flat muscle from the internal condyle of the femur, and partly from the capsule of the knee-joint. It passes downwards and outwards, ending a little below the middle of the leg in a small flattened tendon. The lower four inches are sheathed in a strong aponeurosis derived chiefly from *biceps femoris.* *Gastrocnemius externus* and *internus, semimembranosus, semitendinosus*, and the aponeurosis from *biceps femoris* unite to form the common tendon of the os calcis.

C. and L.—276–7; 285–6; 289, figs. 3, 4; 292 (a^1).

Popliteus arises by a round tendon from the external condyle of the femur, beneath the external lateral ligament. The muscle occupies a deep groove, lined with cartilage and synovial membrane, which lies obliquely above the head of the fibula, and is inserted into a triangular surface of considerable extent on the posterior aspect of the upper half of the tibia. Below and to its outer side, *popliteus* is bounded by a strong ligamentous band, which stretches from the tibia to the head of the fibula. Part of the muscle is inserted into the deep surface of this band.

C. and L., 289, fig. 4 (*v*).

Plantaris arises from the posterior surface of the external condyle of the femur by a roundish mass of muscular fibres. About the junction of the upper and middle thirds of the leg it passes into a tendon, very similar to that of *gastrocnemius internus*, but more slender. It passes beneath that muscle towards the middle of the leg, and receives an investment from the fascia. On reaching the os calcis, *plantaris* spreads out into a thin fascia, separated from the heel by a bursa. Externally, it is connected with a strong annular ligament which surrounds the tarsus. *Plantaris* is finally inserted into the plantar fascia, *q.v.*

C. and L. ("Gastrocnemien externe").—274–5; 276–7; 285–6; 287–8; 289, figs. 3, 4 (*a*).

Soleus arises by a thin, flat tendon from the posterior and external surface of the head of the fibula, and from the intermuscular septum between it and the *peronæi.* It is inserted by fleshy fibres into the upper part of the tuberosity of the os calcis, beneath the common tendon, but closely blended with it. *Soleus* is channelled by several large veins, which course longitudinally through it.

C. and L.—274–5; 276–7; 287–8; 289, figs. 3, 4; 292–3 (β).

Peronæus longus arises from the head of the tibia, and from strong fibres which pass over the capsule of the knee-joint. It becomes tendinous, and passes down into a groove behind the external malleolus, external to *Peronæus brevis.* The muscle winds round the outer edge of the foot, to be inserted deeply, beneath the calcaneo-cuboid ligament, into the posterior border of the cuboid. A small part of the tendon passes further into the sole, towards the bases of the metatarsals.

C. and L.—274–5; 276–7; 287–8; 289, figs. 1, 2, 3, 4 (ϵ). Mayer states (incorrectly), that *peronæus longus* is pierced by the peroneal nerve.

Peronæus brevis arises from nearly the whole of the outer surface of the fibula. It becomes tendinous along its anterior border immediately above the external malleolus; but the muscular fibres are prolonged nearly to the insertion along the posterior border. The tendon lies in the groove behind the external malleolus, and is separated from that of *peronæus longus* by a division of the external annular ligament. It then crosses the base of the 5th metatarsal, and is inserted principally into the fibular side of the metatarsal of the 4th digit; also, by a small slip, into the proximal phalanx of the 5th. *Peronæus brevis* underlies *P. longus,* and is much broader than that muscle. The peroneal nerve passes between them.

C. and L.—274–5, but incorrectly drawn and not lettered; ϵ^1 is put upon another muscle; 276–7 (ϵ^1); 287–8 (ϵ^1); 289, fig. 3 (ϵ^1), figs. 1, 2, 4, not lettered; ϵ^1 of these figures is our *P. anticus.*

Peronæus anticus arises by a round tendon from the external lateral ligament of the knee, and by a second head from the top of the tibia and lower two-thirds of the front of the fibula, adjacent to the tibia. It divides into two main slips. The more superficial passes outwards, and is inserted into the outer border of the 5th metatarsal. The deeper portion is subdivided into two parts, of which the shorter passes to the 4th and 5th metatarsals; the longer to the fibular side of the 4th. A slip from the anterior border of the external malleolus blends with the muscle. This accessory slip would agree with *P. tertius.*

C. and L.—274–5 (ϵ_1, ϵ_2); 276–7 (ϵ_2); 287–8 ($+ \epsilon_1$, accessory slip); 287, fig. 1 (ϵ_1); fig. 2 ($\epsilon_1 + \epsilon$); fig. 4 ($+ \epsilon_1$, accessory slip). Not in Mayer.

Rectus femoris arises partly from the notch between the anterior spine of the ilium and the border of the acetabulum. The tendon of attachment arches over the centre of the concavity. Between it and the bone is a large branch of the external iliac artery, and a considerable venous anastomosis. The external head arises from the root of the great trochanter on its anterior surface, and extensively from an intermuscular septum between this muscle and *vastus externus.* The long head is inserted into the front of the patella; the external head has a slightly distinct insertion above, and to the outer side of the other.

C. and L.—285–6 (*p*); 287–8 (*p*); 290–1 (*p*); 292–3 (*p*); 294, fig. 1 (*p; m,* and *o* perhaps represent the external head).

Vastus internus arises from the lower half of the femur on its inner surface. It becomes very thick and fleshy in its lower part, and is inserted into the inner border of the patella and the ligamentum patellæ.

C. and L.—285–6 (*n*); 290–1 (*n*); 292–3 (*n*); 294, fig. 1 (*n*).

Vastus externus arises from the outer surface of the trochanter, and from nearly the whole length of the femur along its outer border. The line of origin then curves out towards the external condyle. The muscle is inserted, chiefly by fleshy fibres, into the outer side of the patella, into the ligamentum patellæ, and the aponeurosis of the leg.

C. and L.—276–7 (the right-hand *m*); 287–8 (*m*); 289, fig. 2 (*m*); 290–1 (*m*); 294, fig. 1 (*m*).

Crureus arises from nearly the whole anterior surface of the femur, and from the lower part of the external surface of the trochanter. It sends processes of attachment between the adjacent muscles, thus embracing by pointed slips the femoral origin of *rectus,* and the insertion of *glutæus minimus.* It is inserted into the upper border of the patella. This muscle is much divided by vessels and tendinous septa.

C. and L.—290–1 (*o*); 294, fig. 1 (*o*). Mayer appears to consider this muscle a part of *vastus externus.*

Tibialis anticus is the most internal of three muscles which occupy the front of the leg, and which are hardly separable above. It arises from the external surface of the tibia, for the middle three-fifths of the length of the bone, passing downwards and slightly inwards to its insertion into the metatarsal of the 2d digit. It crosses the tendon of *tibialis posticus,* close to its insertion. *Tibialis anticus* is fleshy almost to its termination.

C. and L.—285–6 (δ); 287–8 (δ); 289, figs. 1, 2 (δ); 292–3. Mayer states that this muscle is inserted into the cuboïd and 1st and 2d metatarsals.

Extensor communis digitorum arises from the tibia, external to *tibialis anticus,* for nearly the whole length of the bone; also from the intermuscular septum on its outer side. Passing downwards, it spreads out, and becomes tendinous over the tibio-tarsal articulation. It finally divides into four slips, which are inserted into the upper surface of the digits. The tendons to the third and fourth toes are much stronger than the rest. That to the fourth gives off a slip to the base of the proximal phalanx, an arrangement which does not exist in the other tendons.

C. and L.—274–5 (ζ); 276–7 (ζ); 285–6 (ζ); 287–8 (ζ); 289, figs. 1, 2 (ζ); 292–3 (ζ). The slips appear more distant from each other in the drawings than in our dissections.

Extensor brevis digitorum has an oblique origin from the dorsum of the tarsus, following a line drawn to connect the external malleolus with the base of the second metatarsal. The dorsal vessels pass between the two main divisions of the muscle, close to its origin. The outermost and highest head of *extensor brevis* is partly concealed by a strong ligamentous band connected with the external lateral ligament. Opposite the heads of the metatarsal bones the muscle blends with the under surface of the tendinous expansion of *extensor communis digitorum,* but the deeper fibres pass into a strong ligament which encloses the heads of the metatarsals and the bases of the first phalanges. No part of the muscle is attached to the first or second digits.

C. and L.—276–7 (θ); 287–8 (θ); 289, figs. 1, 2 (θ); 292–3 (θ). Mayer's brief account is very accurate.

We have not found the muscle named extensor of the metacarpus, and lettered + ζ by Cuvier and Laurillard.

Tibialis posticus is concealed beneath *flexor longus digitorum.* It arises from the posterior surface of the tibia, below what answers to the oblique line; from the adjacent surface of the fibula; and largely from the intermuscular septum between this muscle and *flexor longus digitorum*. It ends in a tendon, which passes through a distinct sheath on the inner malleolus, and is inserted into the upper surface of the basis of the second and third metatarsals, being crossed, immediately above its insertion, by *tibialis anticus.*

C. and L.—239, fig. 4 (δ^1); 292–3 (δ^1). Mayer's description is very incorrect; the muscle is said to pass over the outer malleolus, and to blend with *tibialis anticus.*

Flexor communis digitorum arises by tendinous and fleshy fibres from the postero-internal surface of the head of the fibula. An additional slip, small and tendinous, proceeds from the tibia, internal to the insertion of *popliteus*, from the oblique ligament between the tibia and fibula, and from the septum between *flexor communis* and *tibialis posticus.* The muscle becomes tendinous opposite the tuberosity of the os calcis, and passes into the sole along a groove at the junction of the astragalus with the sustentaculum tali. *Flexor longus hallucis*; a larger muscle than the last, arises from the posterior and internal surfaces of the fibula, and from the septum between the two muscles. It passes through a distinct sheath. Opposite the ento-cuneiform bone *flexor digitorum*, which lies superficial to the other, spreads out, and blends by its deep surface with the tendon of *flexor hallucis.* The separate flexor tendons are given off after this junction. The small tendon to the first digit, and that to the fifth, are furnished almost entirely by *flexor digitorum*, while those to the middle digits proceed from the two flexors jointly. There is no trace of a short *flexor digitorum*, unless the *lumbricales* from *plantaris* represent it. In the flexor sheaths there is on each side a strong band, which passes to the second phalanx, and the two bands enclose the tendon, very much as the *perforatus* usually encloses the *perforans.* In the case of the third digit, a lumbrical muscle is distinctly inserted into one of these bands.

C. and L.—285–6 (ι); 289, fig. 3 (ι), 4 (ι). In this figure the tendon is not correctly drawn—292–3 (ι_1). The above refer to *flexor communis digitorum; flexor longus hallucis* is shown in 289, fig. 3 (ι_1), fig. 4 (ι); 295–3 (ι).

The plantar fascia is exceedingly strong on the outer side of the foot, forming a sheath for the short muscles of the fifth digit. In front, it is firmly connected with a strong transverse band, which stretches across the sole over the heads of the metatarsal bones. The fascia is not so strong on the inner side of the foot; here it blends with the other connective tissues of the sole. Close to the inner side of the tuberosity of the heel, a rather strong tendinous portion of *plantaris* passes deeply. The first *lumbricalis* is attached to this; beyond, the tendinous slip gives off a bundle of fibres to the deep flexor tendon, and itself ends in a small round tendon, from which the third and fourth *lumbricales* take origin.

The general disposition of the superficial ligaments of the sole is similar to that of the fore-limb. A synovial bursa and a great quantity of highly elastic connective tissue in each case separates the ligamentous from the horny sole.

Lumbricales.—The first, short and much stronger than the rest, arises from the tendon of *plantaris* on its inner side, close to the tuberosity of the os calcis. It is inserted by a flattened tendon into the tibial side of the first phalanx of the first toe. The tendon of *plantaris,* prolonged towards the middle digit, gives off next, on the inner side, the second lumbrical, which passes to ths flexor sheath of the second toe. On the other side two *lumbircales* arise, close together, from the tendon of *plantaris.* One passes to the sheath of the flexor tendon of the third digit, the other similarly to that of the fourth. The *lumbricalis* of the third digit arises also by a small head from the deep flexor just above its division. Another lumbrical, given off at the same point, is inserted into the tibial side of the sheath of the third digit, and is connected further with the extensor tendon. A shorter and thicker lumbrical arises from the flexor tendon just behind the preceding, and passes to the tibial side of the second digit, where it is attached, like the rest, to the deep surface of the sheath. There is no *lumbricalis* of the fifth digit.

C. and L.—289, figs. 4, 5 (λ); 292–3 (κ).

Abductor minimi digiti (pedis).—A short, thick muscle, arising from the under surface of the tuberosity of the os calcis, and inserted by means of a sesamoid into the proximal phalanx of the fifth digit.

Not in C. and L.

Adductor minimi digiti.—A smaller muscle than the last. Arises from under surface of os calcis, in front and to the inner side of the *abductor;* also from calcaneo-cuboid ligament. Inserted into the sesamoid just mentioned to the inner side of the *abductor.*

Not in C. and L.

Flexor brevis hallucis.—A small, short muscle, arising from the sustentaculum of the os calcis, beneath a strong ligamentous band which stretches across the centre of the tarsus.

Not in C. and L.

Interossei (pedis).—Only a single plantar *interosseus* can be distinguished. It arises from the tarsus, opposite the bases of the third and fourth metatarsals, and is inserted into the fibular side of the base of the second digit. The second, third, and fourth digits are provided with dorsal *interossei,* almost exactly resembling those of the manus.

Not in C. and L.

MUSCLES OF THE HEAD AND TRUNK—FACIAL MUSCLES.

Occipito-frontalis.—A double-bellied muscle, with intermediate tendon. The posterior belly, the larger of the two, arises from the cranial aponeurosis along a line connecting the two auditory apertures. The anterior belly arises from the supra-orbital region, partly blending with the *orbicularis palpebrarum.*

C. and L.—274-5 (1*a*), anterior belly—"surciliers."

Platysma myoides (facial portion of *Panniculus*).—This muscle, passing over the angle of the jaw, is inserted as follows:—A few of the lower fibres pass to the outer surface of the horizontal ramus of the mandible, a little in front of the facial artery, where it crosses the bone; the uppermost fibres to the facial aponeurosis below the zygoma; the intermediate and principal portion of the muscle converges to the angle of the mouth, where its fibres interlace with those of *orbicularis oris* and *levator anguli oris.*

C. and L.—272-3 (2, 4), "facien"—"thoraco-facien."

Cutaneous muscle of the occiput.—This is described by Dr Watson as arising from the cranial aponeurosis of the posterior surface of the skull. The fibres pass transversely outwards to be inserted into the cranial aponeurosis immediately behind the origin of the posterior belly of the *occipito-frontalis*. This muscle was not met with in our dissection.

Not in C. and L.

Zygomatico-labialis arises from the zygoma, and runs parallel with the upper border of *platysma*, partly blending with it, to the angle of the mouth.

Not in C. and L.

Orbicularis oris forms a tolerably distinct bundle, which passes from the middle line of the lower lip, where it joins the corresponding muscle of the opposite side, to the angle of the mouth. Here it is partly blended with fibres of *platysma* and *zygomatico-labialis*. The muscle is continued forwards along the margin of the upper lip, becoming stronger and well-defined as it passes the socket of the tusk, beyond which it is united with *levator proboscidis*.

C. and L.—274-5 (*l*) ; not in the index.

Levator labii superioris arises immediately below the origin of *orbicularis palpebrarum*, slightly overlying the origin of *levator proboscidis*. It passes almost directly downwards, and blends with *orbicularis oris*. Dr Watson gives a similar origin to this muscle, but describes an anterior portion as inserted into the lip; while a posterior, weaker bundle is inserted into the facial aponeurosis beneath the eye.

C. and L.—274-5 (not lettered); 276-7 (*i*), "grand zygomatique."

Levator anguli oris consists of about six fasciculi, which arise from the maxilla, below and internal to the infra-orbital foramen. It passes thence backwards and downwards, and ends by interlacing with *orbicularis oris* and *platysma*.

Not in C. and L.

Orbicularis palpebrarum.—This muscle is considerably more developed below the aperture of the eye than above. It arises from a tubercle upon the inner margin of the orbit. The fibres pass downwards and outwards, spreading out into a semicircle below the eye. The lower fibres extend over the zygomatic process of the maxilla, becoming indistinct towards the outer side of the orbit, and finally losing themselves in the fascia. Dr Watson describes a more elaborate arrangement of the fibres than we were able to distinguish in our example.

C. and L.—274-5 (*d*).

MUSCLES OF THE PROBOSCIS.

The proboscis of the elephant has been fully and accurately described by Cuvier, but the arrangement of its muscles is included in the present account for the sake of completeness. This organ in the elephant differs from the somewhat similar snout of certain Insectivora (*e.g.*, Macroscelides) in its homologies and internal structure. The insectivorous snout derives its form and extent from the great development of the nasal cartilage; whereas the proboscis of the elephant consists wholly of muscular and membranous tissue, the nasal cartilages simply serving as valves to the entrance of the bony nares. The muscles consist of a superficial set, the fibres of which are more or less longitudinal in direction, and a deep set, which are radiate and transverse. The longitudinal muscles are further divisible into anterior, lateral, and posterior.

Levatores proboscidis, or anterior longitudinal, arise from the frontal bone, along a semicircular line arching upwards above the nasal bones and between the orbits. The muscles of the two sides blend, and their fasciculi, running in nearly straight lines, extend the entire length of the proboscis along its anterior surface, and are continued into the finger-like process at its extremity.

C. and L.—274–5; 276–7; 278, fig. 1; 279, figs. 1, 2, (3); 280 (*a*).

Depressores proboscidis, or posterior longitudinal, arise from the anterior surface and lower border of the premaxillæ, and form two layers of oblique fasciculi along the posterior surface of the proboscis. The fibres of the superficial set are directed downwards and outwards from the middle line; they do not reach the extremity of the trunk, but disappear by curving over the sides a little above the end of the organ. The fibres of the deeper set take the reverse direction, and are attached to a distinct tendinous raphe along the posterior median line.

C. and L.—274–5; 276–7; 278, fig. 2; 279, fig. 2 (4?); 280 (*c*).

The *lateral longitudinal* muscles consist of two portions on each side; one is derived from *orbicularis oris*, the other springs from the anterior margin of the orbit. They are inserted by a series of slips between the anterior and posterior longitudinal muscles along the proximal half of the proboscis.

All these muscles are very intimately connected with the integument, especially in the lower two-thirds of their extent.

C. and L.—274-5; 276-7; 279, fig. 2 (5); 280 (*b*).

The foregoing muscles form a sort of sheath to the deep radiating and transverse muscles, which, with the nasal canals, make up the bulk of the proboscis. The deep muscles are best seen in a cross section of the trunk.

The *radiating* muscles consist of very numerous distinct fasciculi, stretching directly outwards between the anterior and lateral surfaces of the nasal canals and the skin.

C. and L.—280 (*d*).

The *transverse* muscles are in two sets—one short, between the nasal canals; the other longer and intermixed with a few oblique radiating fibres, behind the canals, and between them and the posterior longitudinal muscles.

C. and L.—280 (*e*).

MUSCLES OF THE EXTERNAL EAR.

Zygomatico-auricularis (portion of *attrahens superior*, Watson).—A rather strong muscle. Arises from the outer surface of the root of the zygoma, and is inserted into the posterior surface of the cartilage of the ear, immediately behind and below the meatus.

C. and L.—274-5 (XII.), "parotido-aurien."

Attrahens superior (upper portion of *attrahens superior*, Watson).—A small quadrilateral muscle. Arises from temporal fascia and bone anterior to the aperture of the ear, where the cartilaginous and bony meatus are continuous. Inserted into the aural cartilage, on the lower and anterior surface of the tube.

Not in C. and L.

Attrahens inferior arises from the root of the zygoma, close to the meatus, and beneath *attrahens superior*. Inserted into a small projection of the auricular cartilage which overhangs the meatus.

Not in C. and L.

Tragicus arises from the cartilaginous anterior border of the meatus. Inserted into the same process of the aural cartilage as *attrahens inferior.*

Not in C. and L.

Cervico-auricularis superficialis (*retrahens inferior,* Watson).—Arises from the cervical fascia, near the occipital ridge. Inserted into the back of the pinna, near the middle of its upper border.

C. and L.—272–3 (II., III. ?).

Cervico-auricularis medius (*retrahens anterior,* Watson).—Arises from beneath the last-named muscle. Inserted into the back of the pinna, below the insertion of *occipito-auricularis.*

C. and L.—274-5 (X. ?).

Cervico-auricularis profundus (*retrahens internus,* Watson).—Arises from the fascia beneath the two last-named muscles. Inserted into the back of the pinna, opposite the external auditory meatus.

C. and L.—274–5 (XI. ?).

Occipito-auricularis (*retrahens superior,* Watson).—Arises from the cranial aponeurosis, along the occipital ridge. Inserted into the back of the pinna, beneath the insertion of *cervico-auricularis superficialis.*

C. and L.—274–5 (IX. ?).

Attollens superior arises from the cranial aponeurosis above the ear. Inserted into the back of the pinna, in advance of *cervico-auricularis superficialis.*

C. and L.—272–3 (upper part of I. ?).

Attollens inferior consists of two portions, the posterior of which crosses the anterior superficially and obliquely. Arises beneath *attollens superior* from the cranial aponeurosis, also from the cervical fascia by the mediation of two slight muscular slips. Inserted into the pinna, above the cartilaginous auditory meatus.

C. and L.—272–3 (IV., V. ?). There is no close correspondence between Cuvier's dissection of the muscles of the external ear and our own.

MASTICATORY MUSCLES.

Temporalis arises from the temporal fossa, and is inserted into the inner surface of the anterior half of the ascending ramus of the mandible. The muscle is very thick where it passes beneath the zygoma; above this level are numerous tendinous septa. The anterior fibres are united to a powerful tendon of insertion, while the posterior fibres are muscular throughout.

C. and L.—274–5 (*b*) (temporal fascia); 276–7 (*b*); 287–8 (*b*).

Masseter.—The principal portion of this muscle arises from the lower border of the zygoma, extending from below the eye to the insertion of *sterno-maxillaris.* The fibres pass downwards and backwards, to be inserted into the lower two-thirds of the ascending ramus of the mandible as far as the angle. Some of the deeper fibres arise from the posterior third of the internal surface of the zygoma, pass forwards, and are inserted into the mandible immediately below the sigmoid notch.

C. and L.—274–5 (*j*); 276–7 (*j*, *j*^{1}).

Pterygoideus externus arises from the upper part of the external surface of the pterygoid bone. Inserted into the neck of the mandible and into the inter-articular fibro-cartilage.

C. and L.—287–8 (*p*).

Pterygoideus internus arises from the outer surface of the pterygoid bone, below and slightly behind *pterygoideus externus.* Inserted into the internal surface of the mandible below the dental foramen.

C. and L.—287–8 (*p*^{1}); 290–1 (not lettered).

Mayer speaks of the internal pterygoid as "narrow and short," while the external pterygoid is "thick and broad." The relative strength was exactly reversed in our specimen. Superficial to *temporalis* are the temporal fascia, a venous plexus, the temporal artery, and the temporal gland. Beneath the muscle is an important venous plexus. The *masseter* is crossed immediately below the zygoma by a small artery, a vein (which joins the facial vein), the trunk of the facial nerve, and the parotid duct.

Buccinator.—Our notes of this muscle are incomplete. Dr Watson's description, which we have verified in its principal features, is as follows:—"*Buccinator muscle* arises from the alveolar margins of both jaws, as well as from a powerful elastic ligament which extends from the styloid process down to the lower jaw. The fibres pass forward, and blend with the other muscles surrounding the opening of the mouth. The muscle is further strengthened by the addition of two muscular bundles, which arise from the alveolar margin of the upper jaw, between the tusk and molar tooth. Of these, the anterior passes downwards, and blends with the fibres of the zygomatico-labialis, whilst the other, passing obliquely backwards, is inserted into the ligament which gives attachment to the fibres of the buccinator muscle in the interval between the upper and lower jaws. The muscle is pierced by the duct of the parotid gland."

ELEVATORS OF THE HYOID BONE—DEPRESSORS OF THE MANDIBLE.

Digastricus arises from the skull behind the articulation of the stylo-hyal. The superficial portion is inserted directly into the angle of the mandible; the deeper fibres into the posterior border of the posterior process of the stylo-hyal, and continued forwards by an equally strong muscular mass which arises from the anterior border of the same process, and blends with the superficial portion.

C. and L.—274–5 (*q*); 276–7 (*q*); 287–8 (*q*); 292–3 (*q*).

No tendinous intersection of *digastricus*, such as Mayer and Watson describe, was found.

Stylo-hyoideus may be represented by the deep fibres of *digastricus.*

Mylo-hyoideus arises from the inner border of the mandibular ramus, between the angle and the symphysis. It is inserted into the lower border of the greater cornu of the hyoid bone, and into the tendinous arch which crosses the thyro-hyoid membrane; the anterior fibres blend with the muscle of the other side.

C. and L.—287–8 (*r*); 292–3 (*r*).

Genio-hyoideus arises from the posterior surface of the mandibular symphysis, and is inserted into the upper border of the body of the hyoid bone.

C. and L.—281, fig. 2 (t^1).

The posterior part of *mylo-hyoideus* is covered by *sterno-maxillaris. Genio-hyoideus* is seen when *mylo-hyoideus* is reflected. Still deeper lie *hyo-glossus minor* and *genio-glossus.* The internal jugular vein emerges close to the inner side of *digastricus*. The parotid gland lies superficial to this muscle, and the external carotid artery beneath it.

Depressors of the Hyoid Bone.

Sterno-hyoideus wanting.

Sterno-thyroideus arises from the first rib, external to its sternal articulation, and is inserted into the oblique line of the thyroid cartilage.

C. and L.—276–7 (x^1); 281, figs. 1, 2 (x^1); 287–8 (x^1); 292–3 (x^1).

Thyro-hyoideus arises from the oblique line of the thyroid cartilage, and is inserted into the basi-hyoid.

C. and L.—276–7 (*y*); 281, fig. 2 (*y*); 287–8 (*y*); 292–3 (*y*).

These muscles occupy very much their usual position. Both are overlaid by *sterno-maxillaris*, which extends nearly to the middle line. The two *thyro-hyoidei* are almost continuous, but the *sterno-thyroidei* divide so as to expose the larynx between their internal edges.

Muscles of the Tongue.

Genio-glossus arises from the mandibular symphysis in its whole depth, and is inserted into the under surface of the tongue. The muscle has its usual fan-like arrangement, the lower fibres being horizontal, the upper nearly vertical.

C. and L.—281, fig. 2 (*t*).

Hyo-glossus major (*hyo-glossus lateralis*, Watson) arises from the outer surface of the greater cornu of the hyoid bone. It passes upwards and forwards to the side of the tongue, where it blends with the other lingual muscles.

C. and L.—276–7 (*v*); 281, fig. 2 (v^2); 287–8 (*v*); 292–3 (v^2), "cerato-glossus."

Hyo-glossus minor (*hyo-glossus anterior*, Watson) arises from the anterior edge of the body of the hyoid bone, immediately adjacent to its fellow muscle, and is inserted into the lateral margin of the tongue, blending with *stylo-glossus*.

C. and L.—281, fig. 2 (*v*), "hyo-glossus."

Stylo-glossus arises from the apex of the anterior pointed process of the stylo-hyal bone and stylo-maxillary ligament. Inserted into the lateral margin of the tongue, partly in common with *hyo-glossus minor*.

C. and L.—281, fig. 2 (s^2).

Dr Watson has described the peculiar relation of the last three muscles to the pharyngeal pouch. This cavity, lying in the arch of the hyoid bone, is embraced around its narrow outlet by the muscles passing from the hyoid to the tongue. The *stylo-glossus* and some of the fibres of the *superior constrictor* act as a sphincter; the *hyo-glossus minor* and *genio-hyoid* reduce its vertical dimension; while the depressors of the hyoid bone enlarge the cavity of the pouch.

When the *genio-hyoid* is divided, the *genio-glossus* is seen to form a very narrow ellipse, extending from the mandibular symphysis to the body of the hyoid. In front, the sub-lingual glands lie between and beneath the two muscles. The posterior extremity of this pointed ellipse is embraced by the diverging *hyo-glossi minores,* which pass forwards on each side of the tongue, and are joined on their outer sides by the *stylo-glossi.* The small interval between the straight portions of the *genio-glossus* and *hyo-glossus minor* is occupied by a large branch of the hypoglossal nerve and the lingual artery. The nerve is innermost, and runs superficial to (*i.e.*, beneath) *hyo-glossus minor*, while the artery is partly concealed by it. Branches of the gustatory nerve enter the same space, and form loops with the hypoglossal. External to the *stylo-glossus* lies a large vein. The *stylo-glossus* is, during part of its course, in contact with the mucous membrane of the mouth.

ABDOMINAL MUSCLES.

Panniculus (abdominal portion).—The muscle forms an extensive sheet upon the sides of the body, increasing in thickness below, where it is continued into the fasciæ of the fore and hind limbs. A tolerably distinct scapular portion may be traced.

C. and L.—272–3 (5*d*, 5*c*).

Rectus abdominis arises by a broad thin tendon from the posterior border of the inferior surface of the pubic symphysis. An expansion of the tendon is continued forwards, and closely attached to the symphysis in its lower three-fourths, as well as to the adjacent rami of the pubes. The two tendinous layers form thus a kind of flattened pouch, communicating with the abdominal cavity, and lined with the peritoneal membrane. The free part of the tendon adheres to the inner or superior surface of the thick abdominal aponeurosis. The muscle expands as it passes forward, and again contracts towards its insertion into the sternum. Eight tendinous intersections occur.

C. and L.—287–8 (15).

Obliquus externus takes origin from all the ribs, at least as far forward as the third. The fibres pass downwards, and are inserted into the abdominal aponeurosis. About six interdigitations with *serratus magnus* may be made out.

C. and L.—274–5 (13); 276–7 (13); 282, upper figure (13).

Obliquus internus is less extensive than *externus*. The fibres converge to a thin aponeurosis continuous with the sheath of *rectus*, and closely attached to the outer surfaces of the cartilages of the ribs.

C. and L.—276–7 (14); 287–8 (14).

Transversalis abdominis arises by interdigitations with the diaphragm, from the ribs between the second or third and the seventeenth (inclusive); also from the eighteenth, nineteenth, and twentieth ribs. The ventral portion takes origin as a thick fleshy mass from the anterior superior spine of the ilium, and from a small part of Poupart's ligament adjacent thereto. The muscle passes thence horizontally inwards towards the middle line, and is lost upon the inner surface of the abdominal fascia.

C. and L.—287–8 (17).

The *Diaphragm* arises by fleshy fibres from all the ribs from the second or third to the seventeenth. As far back as the thirteenth rib, the muscle is chiefly attached to the costal cartilages; behind the thirteenth to the ribs themselves. The crura arise from the three hindmost dorsal vertebræ by tendinous processes. The tendon of the left crus is somewhat shorter than the other. A ligamentum arcuatum, entirely tendinous, and united to the central tendon, arches over *psoas*.

Not in C. and L.

Quadratus lumborum arises from the two hindmost ribs, and passes to the innermost part of the crest of the ilium.

Not in C. and L.

The *Intercostal* muscles present the usual arrangement, but are continued unusually far downwards between the costal cartilages.

SUPERFICIAL CERVICAL MUSCLES.

Sterno-maxillaris arises from the first rib, adjacent to the sternum. It forms a strap-like band of nearly uniform breadth (about two inches), but expands greatly, and becomes aponeurotic at its insertion into the lower jaw, at and in front of the angle.

C. and L.—274–5 (*x*); 276–7 (x^2); 287–8 (+*b*); 292–3 (+ b^1).

Sterno-mastoideus.—A muscle which may be held to correspond with this, though it has no attachment either to the sternum or the mastoid, springs from the first rib, several inches above *sterno-maxillaris* (*i.e.*, nearer the vertebral column). It passes obliquely forwards and outwards, contracting to a thin tendon, which finally expands upon the root of the zygoma.

C. and L.—274–5 (*b*); 276–7 (*b*); 287–8 (*b*); 290–1 (*b*); 292–3 (*b*).

MUSCLES OF THE BACK.

Trapezius arises from the ligamentum nuchæ and vertebral aponeurosis between the third and fourteenth dorsal vertebræ. It is inserted into the posterior surface of the spine of the scapula and the superior border of the unciform process.

C. and L.—274–5 (*a*, a^2); 276–7 (a^1, a^2); 287–8 (*a*, a^1, a^2). An occipital origin is ascribed to this muscle in the Plates.

Latissimus dorsi arises from the vertebral aponeurosis and the ribs from the ninth to the fourteenth. The fibres become twisted, and converge to a tendon which is inserted into the neck of the humerus. The tendon of insertion is divided; the superficial portion is inserted above *teres major*, the deeper and smaller part behind it.

C. and L.—274–5 (*i*); 276–7 (*i*); 283, figs. 1, 2 (*i*); 287–8 (*i*). Represented as arising from the sixth to the twelfth ribs.

Rhomboideus major arises from the ligamentum nuchæ between the fourth and six dorsal vertebræ, and is inserted into the postero-superior border of the scapula.

Rhomboideus minor.—Under this name may be distinguished a small slip tolerably distinct from the preceding, which passes from the ligamentum nuchæ opposite the seventh cervical vertebra to the posterior angle of the scapula.

C. and L.—(*Rhomboidei*) 276–7 (c^2); 283, figs. 1, 2 (c^2); 287–8 (c^2).

Serratus posticus arises from the ligamentum nuchæ and the vertebral aponeurosis between the third and tenth dorsal vertebræ. It is inserted into the anterior margins of the ribs from the ninth to the fourteenth inclusive, and also to a strong fascia with much elastic tissue which underlies the *serrati*. The posterior fasciculus of the muscle is separable from the rest.

C. and L.—282, upper figure (10); 287–8 (10).

Levator anguli scapulæ is directed obliquely across the lower part of the side of the neck. Its most forward attachment is to the front of the transverse process of the atlas by means of a thin, flat, tendinous slip. This portion of the muscle crosses superficially the insertion of *transversalis colli*. The lower portion, which is separated by an interval from the rest, arises by similar slips from the posterior tubercles of the transverse processes of the five lower cervical vertebræ. This part of the origin is overlaid by *transversalis colli*. In the dorsal region the muscle takes origin from the articular processes and angles of the ribs between the first and fifth dorsal vertebræ. *Longissimus dorsi* separates these two origins. The muscle passes downwards, and in part backwards, to its insertion into the anterior border of the scapula.

C. and L.—274–5 (d); 276–7 (d, d^1); 283, fig. 1 (d, should be d^1); 287–8 (d, d^1).

Splenius.—This muscle consists of two superimposed layers. The superficial layer, which is thinner and narrower than the other, has a tendinous origin from the ligamentum nuchæ in the anterior dorsal region. The tendon narrows as it passes forward, and reaches the level of the third cervical vertebra. Muscular fibres are given off from it on both sides, but the internal fibres much preponderate, especially in the dorsal and posterior cervical region. Towards the occiput the fibres radiate equally on both sides from the fore end of the tendon. The muscle has an extensive insertion, first, to a median ligamentous raphe continuous with the ligamentum nuchæ; secondly, to the inner two-thirds of the superior curved line of the occiput. The deep layer has a similar arrangement, but its breadth is greater, and the tendinous centre much larger in proportion to the muscular part. It is inserted into the whole length of the superior curved line.

C. and L.—276–7 (K); 282, upper figure (K); 287–8 (K).

Sacro-lumbalis and its forward continuations form a thin, flat sheet, which extends as far as the fourth rib. The tendons arise primarily from the ilium; subsequently from the ribs between the sixth and nineteenth (inclusive), a little external to the angles. The tendons of insertion are somewhat narrower than the tendons of origin, and pass to the posterior borders of the ribs between the fourth and sixteenth (inclusive), nearly four inches external to their angles.

No separate *erector spinæ* exists.

C. and L.—282, figs. 1 and 2 (C); 295 (C).

Longissimus dorsi is inseparable behind from *spinalis.* It diverges from that muscle about the level of the twelfth rib, and is continued forward to the neck, having the continuation of *sacro-lumbalis* on its outer, and *semi-spinalis* on its inner side. In the anterior dorsal region *longissimus dorsi* is enclosed between the two origins of *levator anguli scapulæ.* It is inserted along its whole length by a series of tendons into the transverse processes of the vertebræ. The tendons of origin arise similarly from the transverse processes, but a little to the inner side.

C. and L.—282, figs. 1 and 2 (B); 295 (B).

Transversalis colli continues *longissimus dorsi* forward as far as the atlas, arising from articular processes, and inserted into transverse processes.

Not in C. and L.

Trachelo-mastoideus arises by tendinous and fleshy slips from the articular processes of the hinder cervical vertebræ, external to the slips of origin of *complexus.* The muscle forms a flattened band, which passes direct to the mastoid process, and is inserted by tendinous fibres on its superficial aspect, and more deeply by fleshy fibres. The insertion is overlaid by *splenius.* The internal or dorsal border of the muscle is attached to, and partly sheathed in a layer of yellow elastic tissue, which separates *splenius* from *complexus.*

C. and L.—282, upper figure (L¹), the origin is incorrect in the lower figure; 287–8 (L¹).

Spinalis dorsi and *multifidus spinæ* form a continuous muscle, lying internal to *longissimus.* The fibres take origin in the first place from the sacrum and adjacent parts of the ilium, from the under surface of the strong aponeurosis, which extends between *longissimus dorsi* and the spinous processes, and also from the vertebræ themselves along the line of the articular processes. The muscle is inserted by fleshy fibres into the sides of the spines of the vertebræ, as far forward as the fourth dorsal. The slips corresponding to the fourth, fifth, sixth, and seventh dorsal spines are tendinous, and form a strong bundle which passes more or less completely into the ligamentum nuchæ, and into a loop of elastic tissue, which extends between the spines of the second and fourth dorsal vertebræ. The muscle ends in a tendon which arches over the spines of two vertebræ, and is inserted into the side of the spine of the first dorsal.

C. and L.—282, figs. 1 and 2 (A); 295 (A).

Complexus.—Beneath *splenius* a thin layer of yellow elastic tissue is found to enclose a subjacent muscle, and to extend forwards and outwards from the ligamentum nuchæ to the occiput. The muscle thus enclosed is *complexus.* It arises from the articular processes of the four hindermost cervical, and about twelve foremost dorsal vertebræ, slightly also from the ligamentum nuchæ in the anterior cervical region. It overlies the funicular portion of the ligamentum nuchæ, and is inserted into the inner half of the superior curved line beneath *splenius.*

C. and L.—282, figs 1 and 2 (L); 287–8 (L); 295 (L).

Ligamentum nuchæ.—This powerful elastic ligament springs mainly from the spines of the three foremost dorsal vertebræ, which rise successively higher in the order of their numbers. The ligament is also strengthened by the bundle derived from *spinalis dorsi.* Behind the third dorsal vertebræ it passes into the interspinous ligament. At the level of the first dorsal vertebra the ligamentum nuchæ consists of two very distinct masses, one superficial and the other deep, while a less conspicuous median partition may be observed. The upper or funicular portion is free from bony attachment between the spine of the seventh cervical vertebra and the occiput. At its insertion it divides into lateral halves separated by several veins and loose cellular tissue; each of these again breaks up into many distinct fasciculi. On the deeper surface of the funicular portion the yellow elastic is largely replaced by white fibrous tissue. The deep portion of the ligament forms a flattened mass attached to the spines of the six hinder cervical vertebræ.

Opposite the third dorsal vertebra a short, thick bundle of fibres is given off, partly from the ligamentum nuchæ, partly from the spinous processes, and partly from the interspinous ligament. This bundle passes to the apex of the scapula, which is thus strongly connected with the vertebral column.

Semispinalis colli arises in the posterior cervical and anterior dorsal region by muscular slips internal to the origin of *complexus*, and is inserted into the lower border of the spine of the axis.

C. and L.—282, lower figure (L^1 ?) "petit complexus."

Rectus (capitis) posticus major arises by a small round slip from the spinous process of the axis, and is inserted into the occiput, external to the ligamentum nuchæ and beneath *complexus*.

C. and L.—282 (M^2 ?).

Rectus posticus minor arises from the superior arch of the atlas close to its fellow muscle. The two diverge as they pass upwards, and each is inserted into the occiput beneath *rectus posticus major*.

Not identified in C. and L.

Rectus posticus externus, a rather broader muscle than *rectus posticus major*, arises in front of it and more deeply. It is inserted into the occiput, external to *rectus posticus minor*, and more superficially. *Obliquus superior* partly overlies it.

Not identified in C. and L.

Obliquus (capitis) superior, a fan-shaped muscle, arises by two tendinous slips from the transverse process of the atlas. It passes upwards and slightly inwards, and is inserted into the occiput, external to *rectus posticus major*. A considerable nerve, an artery, and two or three veins pass between the heads of origin.

Not identified in C. and L.

Obliquus inferior, a short and stout muscle, arises from the outer surface of the spinous process of the axis, and passes direct to the transverse process of the atlas. Towards its inner border the fibres are rather closely connected with those of *obliquus superior.*

Not identified in C. and L.

Rectus capitis lateralis extends from the transverse process of the atlas to the mastoid process, lying along the anterior border of *trachelo-mastoideus.*

Not in C. and L.

Intertransversales are present, stretching as usual between transverse processes. The longest lie between the atlas and axis.

MUSCLES OF THE TAIL.

Cuvier and Laurillard figure an *ischio-caudalis* (274–5, Q; 282, lower figure, Q), a *sacro-coccygeus superior* (274–5, R; 282, lower figure, R) and a *sacro-coccygeus inferior* (274–5, R^1). The names indicate the bony attachments.

ANTERIOR VERTEBRAL MUSCLES.

Rectus capitis anticus major arises from a prominent tubercle upon the sixth cervical vertebra, and is inserted mainly into the ventral surfaces of the atlas and axis, a small slip passing to the third vertebra.

C. and L.—287–8 (M); 290–1 (+6 ?).

Rectus capitis anticus minor is a small muscle internal to the last, which arises by thin slips from the third, fourth, and fifth cervical vertebræ. It passes upwards and forwards, converging towards its fellow, which it meets close to its insertion into the base of the basilar process.

C. and L.—290–1 (not lettered).

Longus colli is a much stronger muscle, lying symmetrically upon each side of the middle line and internal to the last. The muscles of both sides form together a triangular mass in front of the centre of the cervical vertebræ. They arise from the transverse processes of the third, fourth, and fifth cervical vertebræ; also from the front of the bodies of the third, fourth, fifth, and sixth dorsal vertebræ, and from the heads of the corresponding ribs, and are inserted into the tubercle of the atlas.

C. and L.—290–1 (*o*).

Scalenus anticus arises from the anterior surface of the tubercles of the second, third, and fourth cervical vertebræ by small, rounded tendons. These unite, and pass towards the thorax, being inserted into the second, third, and fourth ribs.

C. and L.—287–8; 290–1 (6, 6*a*, 6*b*).

In dealing with the myology of the Elephant, we thought it advisable, considering the want of any tolerably complete description, to note every important detail which came to light in the course of our dissection. It would be superfluous to treat all parts of the anatomy with the same fulness. The osteology, for example, has long been amply made known, nor would any student value minute descriptions of bones which can be so easily seen and handled. Other parts of the anatomy are known in various degrees of completeness; some thoroughly, some superficially, some hardly at all. Vulpian and Philipeaux have published a lengthy and elaborate description of the heart; Dr Morrison Watson has minutely described the male organs of generation, and other important viscera; the brain has been figured more than once; while scattered memoirs contain particulars of greater or less value respecting other organs. Under these circumstances we shall probably employ our space and the reader's time to the best advantage by a summary of what is already known, corrected and supplemented by our own observations. Although such anatomists as Cuvier, Camper, and Hunter have preceded us, there is still much to be gleaned, more than any single exploration of the field is at all likely to discover.

The osteology and dentition we propose to leave out altogether. Common text-books already contain descriptions sufficient for the naturalist or palæontologist.

ALIMENTARY CANAL AND ITS APPENDAGES.

MOUTH.

The gape of the mouth is small relatively to the bulk of the animal,—a fact which may receive explanation from the precision with which food is passed into the mouth by the proboscis, and the small part which the lips consequently play in the act of prehension. The upper lip has hardly any separate development, but seems a mere lateral expansion of the root of the trunk; the lower lip is small and pointed, its mucous surface forming a narrow groove or gutter in which the tongue is lodged. The cheeks are very capable of distention, but in their ordinary contracted state they enclose only a very small cavity.

The mucous membrane of the mouth is in general smooth; that of the palate in particular is quite smooth, and shows none of the transverse ridges which appear on the hard palate of the horse and ox. Two shallow triangular depressions placed symmetrically immediately in front of the fore edge of the hard palate lead to Jacobson's canals. The bony cavity in which the canals lie runs in the suture between the premaxillæ and maxillæ for 7 or 8 inches (Mayer gives 8 inches), taking a nearly straight direction upwards and backwards; it is furnished with a vertical cartilaginous septum and a cartilaginous lining. Each of the component canals is of about the diameter of a goose-quill, and is lined by an extension of the mucous membrane of the mouth. Camper (p. 48) says that these canals when pressed exude a sticky fluid.

Examination of skulls of different ages seems to show that Jacobson's canals are at first nearly horizontal, but that as the air-cells of the maxilla enlarge, the maxillo-premaxillary suture, and with it the canals, is tilted more and more, until it finally gets a steep slope forwards.

TONGUE.

The tongue is thick and rounded towards its base, tapering and pointed in front. Perrault describes it as 18 inches long, but in our young example it was much shorter. The tip is directed downwards, and lies almost invariably in the groove formed by the lower lip. All observation of the living animal seems to show that the tongue, like the lips, is of little importance in the act of feeding. The oral surface of the tongue ends behind in a prominent concave edge, which forms the front and lower boundary of the pharyngeal pouch. Towards the base are two, four, or more circumvallate papillæ of large size, while on the side, especially behind, are a number of wart-like eminences and mucous crypts.

SALIVARY GLANDS.

The parotid was small in our example, and measured only 4 inches by 3. Dr Watson gives 8 inches by 5 as the dimensions. The gland is connected by a fibrous band with the zygoma; it lies in the space below the zygoma and behind the ascending ramus of the lower jaw. Steno's duct passes out from near the middle of the gland; it is at first of about half an inch diameter, but gradually contracts to the size of a crow-quill. Close to its termination it pierces the *buccinator*, and finally opens into the mouth near the alveolar margin of the upper jaw by a simple rounded orifice without papilla.

No sub-maxillary gland was seen either by Dr Watson or ourselves, though it is described by Mayer. A small lobulated mass, lying between the *genio-hyo-glossi* and close to the symphysis of the mandible, may possibly be a sublingual gland, but we were unable to discover an efferent duct, or to satisfy ourselves as to the exact nature of the body.

SOFT PALATE.

The soft palate, which is hardly distinguishable from the base of the velum palati, extends backwards about 2 inches from the hind edge of the hard palate. Like the nasal passages immediately above, it is narrow from side to side. No *levator palati* was made out. The *tensor palati*[1] arises from the front and outer side of the upper part of the membranous section of the Eustachian tube. It is a small, spindle-shaped muscle enclosed in a sheath of fascia. At the groove of the hamular process it becomes tendinous and spreads out in the substance of the soft palate.

PHARYNX.

The upward extension of the pharynx towards the nasal passages gradually narrows from side to side as it ascends. The antero-posterior dimension is much contracted in the neighbourhood of the soft palate. Above this level, the pharynx is prolonged into the nares in front, and is also continued for some distance backwards as a gradually diminishing cavity which extends beneath the basi-sphenoid to near its junction with the basi-occipital. The ultimate recess (the sinus of Morgagni) just admits the last joint of the forefinger.

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[1] Dr Watson considers that this muscle is absent in the elephant.

The pharyngeal openings of the Eustachian tubes lie in the lateral walls of this part of the pharynx, about an inch above the hamular pterygoid process, and a little above the level of the hard palate. The orifices are large enough to admit the little finger. In its lower part each tube is almost entirely membranous. It runs upwards and a little outwards, and may be explored by a probe for 7 inches. We have been unwilling to destroy the surrounding parts for the sake of tracing the tube further. According to Camper's figures (pl. xiii. figs. 7, 8), the bony tube is about 2 inches long and the cartilaginous tube over an inch. The same author describes and figures an opening from the upper part of the cartilaginous tube into the nasal passage. We find no corresponding opening in the soft parts.

The common aperture of the posterior nares occupies a triangular space 4½ inches high and 2 inches wide. The hind edge of the septum is very thin, and deeply concave above.

Muscles of the Pharynx.

Constrictor pharyngis arises on each side from the thyro-hyal, from the posterior margin of the thyroid cartilage, and from the cricoid cartilage below the arytænoid facet. The fibres pass round the tube of the pharynx, and blend along the middle line behind. The uppermost (or anterior) fibres form a tolerably distinct bundle. The lower fibres curve upwards so as to leave a triangular gap, which is filled by a tapering median bundle of the longitudinal œsophageal fibres.

C. and L.—261, fig. 1 (s^1, x^2, z^2).

Stylo-pharyngeus arises from the internal surface of the anterior branch of the stylo-hyal, close to its origin. The muscle passes downwards along the side of the pharynx and is there inserted.

C. and L.—261, fig. 1 (v^1).

Palato-pharyngeus is largely developed. It arises from the palate and descends to the pharynx, forming a considerable part both of the soft palate and the velum palati. It is inserted laterally on the inner surface of the pharyngeal wall.

A symmetrical venous plexus, which arises by free communications between the internal jugular, internal maxillary, and inferior palatine veins, lies at the back of the mouth, below the soft palate.

The entrance to the pharynx is bounded above by the antero-inferior edge of the velum palati (where its descending and horizontal portions meet); in front and below by the sharp, backward directed edge of the dorsum of the tongue; and laterally by the mucous membrane of the pharynx, with which are connected a number of scattered muscular fibres, and the yellow elastic pharyngeal wall. There is no *palato-glossus.* The passage is very narrow, and cannot in our young example be distended to admit a cylinder of 2 inches diameter.

The velum palati descends from the soft palate, but its chief extension, as in many other large quadrupeds, is horizontally backward. The free posterior edge passes so far back as slightly to overlap the epiglottis. On each side it is continued into a thin elastic fold, which is obliquely attached to the pharyngeal wall, sloping backwards. In the natural position of the parts, the posterior edge of the velum encloses an oval space, the longitudinal diameter being an inch and a half, the transverse somewhat less. Through this aperture the arytænoid cartilages project. The lower ends of the lateral bands of the velum are approximated, but they do not meet; and Dr Watson, therefore, in speaking of the "central" aperture of the soft palate, is to be understood as meaning "in the middle line." The position of the aperture is anatomically the same as in the human subject or as in the majority of mammalia, and altogether below the velum. There is no uvula, but we find a small vertical muscle in the middle line, passing from the soft palate, to be inserted into the back of the upper portion of the velum. This may represent an *azygos uvulæ;* its length does not exceed 2 inches.

The muscular layer of the velum palati forms part of the *palato-pharyngeus.* Its anterior fibres, arising from the palate, pass backwards and a little downwards, to be inserted into the inner surface of the elastic wall of the pharynx, near the free tip of the thyro-hyal. The posterior fibres gradually take a more and more transverse direction, and form the thin muscular sheet which lies in the horizontal valve of the velum. The lateral bands of attachment contain muscular bundles from the same stratum. These bands are separated from the insertion of the anterior fibres of the *palato-pharyngeus* by a considerable elastic pouch, opening backwards into the pharynx, and lined by a continuation of the mucous membrane of that cavity.

Immediately in front of the epiglottis is a vertical transverse elastic fold, which projects from the floor, and especially from the sides, of the pharynx, but not so far as to materially obstruct the passage. Smaller secondary folds proceed backwards from this at right angles, passing longitudinally upon the floor of the pharynx outside the laryngeal aperture. When the pharynx is seen from above and behind, there are therefore visible three cavities on each side, divided from each other by mucous folds. In front of the epiglottis, behind the transverse fold, and inside the longitudinal secondary fold just described, is a small recess, with a small gland in its floor. To the outer side of this is a larger cavity, in which a larger gland can be seen; it is included between the transverse fold, the secondary longitudinal fold, and the lateral attachment of the velum. Between the lateral attachment of the velum and the proper pharyngeal wall is a third and much more capacious receptacle, which has been described in connection with the *palato-pharyngeus.*

The wall of the pharynx is largely composed of yellow elastic tissue, overlaid by the constrictor muscles. The *palato-pharyngeus* lies deeper, and is inserted into the inner surface of the elastic wall.

Dr Watson has described, in connection with the pharynx, a peculiar structure which throws light on a previously unexplained faculty of the elephant, viz., the power which the animal possesses, according to more than one competent observer, of withdrawing large quantities of water by inserting the tip of the trunk into the mouth. He observes that

> "It is evident that were the throat of this animal similar to that of other mammals, this [withdrawal by the trunk] could not be accomplished, as the insertion of a body, such as the trunk, so far into the pharynx as to enable the constrictor muscles of that organ to grasp it, would at one give rise to a paroxysm of coughing, or were the trunk merely inserted into the mouth, it would be requisite that this cavity be kept constantly filled with water at the same time that the lips closely encircled the inserted trunk. The formation of the mouth of the elephant, however, is such as to prevent the trunk ever being

grasped by the lips so as effectually to stop the entrance of air into the cavity, and thus at once, if I may so express it, the pump-action of the trunk is completely paralysed. We find, therefore, that it is to some modification of the throat that we must look for an explanation of the function in question, and this we find to be as follows:—The superior aperture of the pharynx (fig. 1, A) is extremely narrow, so much so as to admit with difficulty of the passage of the closed fist. Immediately posterior to this narrow aperture the pharynx dilates into a pouch of large size (fig. 2, E), capable of containing a considerable quantity of fluid. This pouch is prolonged forward beneath the root of the tongue, and is bounded in the following manner. The floor extends from the epiglottis as far forward as the root of the tongue, being formed from behind forward by the thyroid cartilage, thyro-hyoid membrane, and hyoid bone. Its lateral walls are completed by the sides of the pharynx (that is, by the superior constrictor muscles—fig. 2, F), in addition to the stylo- (G), and hyo-glossi (H) muscles. The root of the tongue forms the anterior boundary, whilst the posterior wall is completed by depression of the soft palate, or when the latter is elevated, the pouch then communicates freely with the œsophagus. In connection with this pouch is to be observed the very peculiar form of the hyoid bone, which, being deeply concave on its upper surface, forms as it were the greater part of the floor of this pouch. Between the pouch and the concavity of the hyoid bone, moreover, there is placed a large quantity of loose and distensible connective tissue, which permits of the expansion of the pouch. The size of the latter is, moreover, liable to alteration by the actions of several muscles. These are more especially the hyo-glossi muscles, and two little additional muscles (fig. 2, K), the homologies of which I have not yet been able to determine, which, springing from the middle line of the hyoid bone, in front of the pouch, pass up, one on either side of the middle line, and blend with the other muscles forming the root of the tongue. By the action of these muscles the pouch may be diminished in *depth;* but in consequence of the narrow interval existing between the hyoid cornua, the *length* of the pouch from before

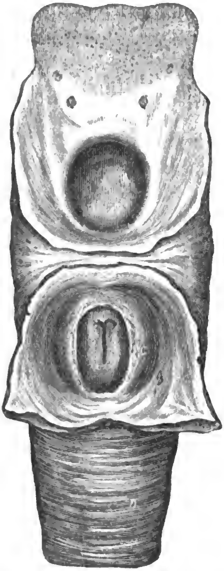

FIG. 1.—A, superior aperture of pharynx. B, root of tongue. C, soft palate with larynx projecting through the centre. D, pharynx.

backwards cannot be altered, as the thyroid cartilage is thereby prevented from being approximated to the hyoid bone. . . . An elephant can, as the quotations sufficiently prove, withdraw water from his

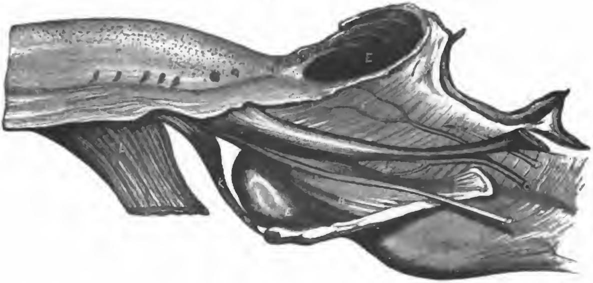

FIG. 2.—E, E, pharyngeal pouch. F, superior constrictor. G, stylo-glossus. H, hyo-glossus. K, small muscle, which diminishes the depth of the pharyngeal pouch. L, genio-glossus muscle. (For the use of the woodcuts of figs. 1 and 2 we are indebted to Professor Turner.)

stomach in two ways: first, it may be regurgitated directly into the nasal passages [1] by the action of the diaphragm and abdominal muscles, the soft palate being at the same time depressed, so as to prevent the entrance of water into the mouth. Having in this manner filled the large nasal passages communicating with the trunk, the water contained in them is then forced through the trunk by means of a powerful expiration; or, in the second place, the water may be withdrawn from the cavity of the mouth by means of the trunk inserted into it. Now, in this case, it is manifestly impossible that the water can be contained within the cavity of the mouth itself, as I have already shown that the lips in the elephant are so formed as effectually to prevent this. The water regurgitated is, however, by means of the elevation of the soft palate, forced into the pharyngeal pouch. The superior aperture of this pouch being much narrower than the diameter of the pouch itself, and being completely surrounded by the muscular fibres of the stylo-glossus on each side, and the root of the tongue in front, which is prolonged backwards so as to form a free sharp margin, we have thus as it were a narrow aperture surrounded by a sphincter muscle, into which the trunk being inserted and grasped above its dilated extremity by the sphincter arrangement just referred to, air is thus effectually excluded, and the nasal passages being then exhausted by the act of inspiration, water is lodged within these passages to be used as the animal thinks fit, either by throwing it over his body, or again returning it into his mouth."

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[1] For remarks on this passage see p. 80.

The chief difficulty attending this explanation springs from the small size of this pharyngeal pouch. In our example, which, it must be remarked, was by no means of full stature, the pouch could not be distended so as to hold a pint of water. This objection is not fatal to the hypothesis advanced by Dr Watson.[1] Regurgitation from the stomach may be effected slowly and continuously until the requisite supply is yielded. It seems to us that the pharyngeal pouch must be unimportant as a mere reservoir of fluid, but as a water-tight circular valve it may be essential to the process of withdrawal. Behind the velum palati is a somewhat larger cavity, but the entrance to the windpipe lies in its floor, and this is not therefore a very likely receptacle of fluid. If our examination of an immature elephant yields data in the least trustworthy, it is hard to suppose that even in the adult a gallon of water can be retained anywhere between the stomach and the proboscis.

We do not know enough of the habits of the living animal to say whether or not the food is moulded and lubricated into a bolus, but the form, structure, and glandular surface of the pharyngeal pouch would be well adapted to such a practice.[2]

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[1] Dr Watson informs us that he considers the pharyngeal pouch unimportant as a mere reservoir, "though the presence of certain muscles not found in other animals would appear to indicate that the elephant possesses a certain power of increasing or diminishing the size of the pouch, and the necessity for this is by no means evident upon the supposition that the sphincter arrangement is the only *raison d'être* of this pouch."

[2] Professor Owen describes the back of the mouth of the Camel in these words:—"A broad pendulous flap hangs down from the fore part of the soft palate, and usually rests upon the dorsum of the tongue. The velum palati extends beyond this process some way down the pharynx, and terminates by a concave border. The pharynx behind the velum dilates into a sac. In the rutting male the palatal flap is greatly enlarged. I have found it extending 10 inches down the pharynx, passing below the margin of the soft palate and the opening of the larynx, into the œsophagus: in the living animal it is, at this season, occasionally protruded, with a belching noise, from the mouth. Its surface shows the pores of innumerable mucous crypts, and in the ordinary state, in both sexes, the flap may apply its own secretion, and water regurgitated from the storage cells of the stomach to the extended surface of the pharynx and root of the tongue so as to allay the feeling of thirst and help the animal to endure the long remissions of drinking to which it is liable in traversing the desert" (*Comp. Anatomy of Vertebrates*, vol. iii. p. 395). In transcribing these remarks, we desire to offer no opinion as to the validity of the explanation offered. The pharyngeal sac described in the camel may throw light on the similar structure in the elephant.

A number of pits in the mucous membrane of the floor and sides of the pharynx are doubtless glandular. They are altogether absent from the middle line, but become densely aggregated towards the root of the tongue on the sides of the pharyngeal floor. Similar glandular crypts line a pouch, in our example about an inch deep and half an inch in diameter,[1] which lies on each side in the lateral wall of the pharynx in front of the transverse fold described above. In the lateral spaces behind the transverse fold are other flattened glands.

The thyro-hyals support the pharyngeal wall laterally, and their expanded ends can be plainly felt upon its inner surface, in the recess behind and within the lateral attachment of the velum. Professor A. H. Garrod has remarked[2] that the basi- and thyro-hyals form a lower arch quite distinct from the bifurcate stylo-hyals, and he adds: "In the elephant, therefore, the deficiency of the lateral intermediate elements of the hyoid apparatus permits of a much greater movement of the base of the tongue than in the ungulata, whose nearly rigid stylo-hyals, epi-hyals and cerato-hyals can allow of little more than an antero-posterior movement of the base of the tongue in part of the circle of which the hyo-cranial attachment in the centre."

ŒSOPHAGUS.

Dr Watson states that "the muscular fibres of the œsophagus are distinctly striated even down to the œsophageal opening in the diaphragm, and are arranged in two layers—an external, the fibres of which are distinctly longitudinal in direction; and an internal, which consists of two sets of spiral fibres, one of which passes from right to left, whilst the other passes in the opposite direction, and thus gives rise to a decussation of the fibres at all points."

Like Dr Watson, we found no trace of a muscle connecting the trachea with the œsophagus and stomach, such as was described and figured by Dr Harrison of Dublin.[3]

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[1] Mayer found this pouch to be 3½ inches long and 1½ wide.

[2] *Proc. Zool. Soc.* May 1875.

[3] *Proc. Roy. Irish Acad.* vol. iv. p. 133 (1847).

STOMACH.

An excellent figure of this viscus is given by Camper (pl. ix. fig. 1). Mayer's drawing is less satisfactory.

The stomach is smooth externally, elongate, and nearly straight. The cardiac end is much prolonged and tapering. A number of transverse nearly circular folds project inwards from the cardiac wall; they almost disappear when the stomach is greatly distended, and are at all times too shallow to serve as water-cells, though they have been figured and described as such.[1] The gastric follicles are most abundant towards the cardiac end, as Mayer has observed. In an adult elephant the stomach is little less than three feet long; the œsophagus enters near the middle but rather nearer the cardiac than the pyloric end. The pyloric valve is well developed.

INTESTINES.

"The duodenum is at first loosely suspended and convolute, as in some rodents; it is more closely attached at its termination. The mucous coat of the jejunum is thrown into small irregular folds, both transverse and longitudinal. There are oblong patches of agminate follicles. The termination of the ileum projects as a conical valve" [a very truncate cone] "into the cæcum. The longitudinal layer of muscular fibres is continued directly from the ileum upon the cæcum; but the circular layer accompanies the valvular production of the mucous membrane, and is there thicker than on the free gut. The large cæcum is sacculated on three longitudinal bands, which are continued some way along the colon."[2]

We find a number of aggregated glands, not unlike Peyer's patches, in the rectum. The occurrence so low down of what are probably absorbents may be partly explained by the slow alteration of food passed along the alimentary canal of the elephant. Even in the large intestine the original form of many pieces of vegetable food is retained, and grains of maize were recognisable in the colon of our example, as were hay and potatoes in the colon of that dissected by Camper.[3]

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[1] Emerson Tennent, *Natural History of Ceylon*, p. 125; see also Perrault, as quoted by Buffon, *Hist. Nat.* vol. xi. p. 109.

[2] Owen, *Comp. Anat. of Vertebrates*, vol. iii. p. 457.

[3] Further observations are necessary before we can be satisfied that these appearances are not due to disease.

Hunter gives 17 feet as the length of the small intestine. Mayer makes it 37 feet, while he gives the total length of the intestines as 75 feet. Professor Owen's measurements, taken from a young Indian elephant about 7 feet high at the shoulder, are as follows[1] :—

	Ft.	In.
Length of the small intestines, . .	38	0
Circumference of ditto., ...	2	0
Length of cæcum, ...	1	6
Circumference of cæcum, . . .	5	0
Circumference of colon, ...	6	0
Total length of colon and rectum together, ...	20	0
Total length of intestinal canal, exclusive of the cæcum, ...	58	6

Our own measurements have unfortunately been mislaid, which is the more to be regretted that the statement of previous observers are very discordant.

PERITONEUM.

Hunter has remarked that the lymphatics and lacteals are small. He found no lymphatic glands on the mesentery proper; there were several on the meso-colon, but these were not larger than in man.

"The peritoneum lining the elastic ventral wall of the abdomen in the elephant and rhinoceros is of unusual thickness and strength; the areolar tissue connecting it to adjacent structures presents aponeurotic firmness; the free surface of the serous membrane I found to be white and opaque; it is generally transparent and opaline or colourless."[2] The absence of fat from all parts of the peritoneum has been remarked by more than one dissector of the elephant. In our example the great omentum was quite clear of fat, as indeed were all parts of the body, except the fibrous pads of the soles of the feet and the orbits.

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[1] *Comp. Anat. of Vertebrates*, vol. iii. p. 458.

[2] Owen, *Comp. Anat. of Vertebrates*, vol. iii. p. 503.

LIVER.

The liver is divided by the suspensory fissure into two lobes, of which the right is the larger. There is no gall-bladder, but the ductus cholædocus expands in the wall of the duodenum into a sacculated pouch, which receives also the secretion of the pancreas. The termination of the duct projects slightly into the small intestine, and is surrounded by a sphincter.

PANCREAS.

The pancreas of the elephant differs little from that of most mammals; it does not reach the spleen.

SPLEEN.

The spleen is long and flat, broader in the centre than elsewhere, and occupies its usual position.

MALE GENERATIVE ORGANS.

Dr Morrison Watson's account of the male organs of the elephant,[1] evidently founded upon a careful dissection, but neglecting no advantage which is to be derived from the comparison of earlier descriptions, is probably the best accessible, and may be consulted for fuller details than are here given. We extract from it most of the particulars which follow:—

TESTIS.

The testis is nearly globular, and lies below the posterior extremity of the kidney. It is entirely invested by peritoneum, except at the upper and external margin where the vessels enter. The epididymis lies on its outer side. The veins leaving the gland are remarkable for their number, large size, and free communications. Ten or twelve vasa efferentia pass into the epididymis, which is continued without interruption or flexure into the vas deferens. With the exception of the last five inches, the vas deferens is convoluted in the whole of its course, and attached to the superior wall of the abdomen by a double fold of peritoneum. In the last part of its course it lies upon the upper surface of the bladder. Here it dilates into an ampulla two inches long, which is closely connected with its fellow. It finally unites with the efferent duct of the vesicula seminalis of the same side to form a common ejaculatory duct, which opens into the urethra.

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[1] *Journ. of Anat. and Phys.* vol. iii. p. 65 (1872).

VESICULÆ SEMINALES.

These have been figured by Camper (pl. v. fig. 1), and described by Cuvier. Each is six inches long by one and a half in diameter, and lined internally by a thick membrane thrown into decussating folds, which become longitudinal towards the urethral end of the sac. A large transverse fold apparently divides the cavity into two compartments. Each vesicula is invested by a thick layer of muscular fibres, continuous with that which surrounds the membranous part of the urethra and the prostate glands.

PROSTATE GLANDS.

These are four in number, two on each side, and of small size, the outer ones being the larger. Each gland opens into the urethra by a single and separate duct.

COWPER'S GLANDS.

These are, as usual, two in number. Each is oval, flattened, and measures two and a half inches by two. The excretory duct is three inches long, and traverses the spongy body, opening separately on the floor of the bulbous portion of the urethra.

MALE URETHRA.

The membranous portion is eight inches long. It is invested by a continuous layer of transverse muscular fibres a quarter of an inch thick. Towards the neck of the bladder these become oblique and continuous with those which invest the prostate glands and the vesiculæ seminales. An extension of the erectile tissue of the bulb surrounds this part of the urethra, thinning off gradually towards the neck of the bladder. The orifices of the various ducts seem to be situated nearly as in the human subject.

PENIS.

Each corpus cavernosum commences by a slightly dilated extremity where it is attached to the ischium, and at once unites with the other crus. An incomplete fibrous septum separates the two along the middle line, while the interior of each is further subdivided by conspicuous but irregular fibrous layers, which are simply enlarged trabeculæ. The corpus spongiosum begins by an elongated bulbous enlargement, and gradually diminishes in diameter towards the free end of the penis, so that its figure is compared to that of a carrot. An elongated body measuring three inches by two and a half, situate on the dorsum of the penis two inches behind its extremity, is believed by Dr Watson to represent the glans.[1] There is a well-marked prepuce. The orifice of the urethra is Y-shaped, the two limbs being directed upwards, and the stem downwards.

The *levatores penis* arise, not from the pubes, but from the upper and outer side of each corpus cavernosum, as well as, and principally, from the tuberosity of the ischium. The joint tendon passes in a strong sheath, derived from the tunica albuginea of the corpora cavernosa, to be inserted, according to Camper, into the glans. The other muscles are, on each side of the lower surface of the penis, (1) a *bulbo-cavernosus,* next to the middle line, (2) an *ischio-cavernosus,* external to the last, and (3) a *compressor of Cowper's gland.*[2] The "transverse muscles of the perineum," figured by Camper (pl. v. fig. 1, HK, IL), were not found by Dr Watson.

The dorsal arteries of the penis lie on each side of the middle line, beneath the *levator* of the same side. The dorsal veins lie to the inner side of the arteries, and form a plexus, communicating with the corpora cavernosa, on the dorsal surface of the root of the penis. The dorsal nerves run on the outer side of the arteries.

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[1] Houel, whose authority is not unimpeachable, figures a kind of glans on the under side of the erect penis.

[2] Dr Watson describes this as lying between the two last muscles. Camper figures a "short accelerator urinæ," which may be the same muscle, above the bulb of the urethra (pl. v. fig. 1, FH, GI).

It will be of interest to give here some passages from a letter of Dr William Ogle, in which are quoted the first extant accounts of the anatomy of the elephant. The description of the generative organs seems to imply actual dissection by some ancient anatomist.

"Aristotle most probably, as I think, never saw an elephant himself, but the following passages from his *Historia Animalium* show that even at that early time some one or other either had or professed to have examined the inside of one.

"II. 17. 'The elephant's intestine is formed of parts so put together as to give the appearance of there being four stomachs. Its viscera resemble those of the hog, but are of course much larger. The liver, for instance, is four times as large as that of an ox. The spleen, however, is of small size, considering the large bulk of the animal.'

"II. 1. 'The penis of the elephant is like that of the horse, but small considering the animal's bulk. The testes are not visible externally, but are placed inside, near the kidneys. The pudendum of the female is placed in the position which in ewes is occupied by the dugs, but for congress is drawn upwards and directed outwards, so as to facilitate the action of the male. It has naturally a wide orifice.'"

FEMALE GENERATIVE ORGANS.

OVARY.

The ovary in our young example was about one-third larger than in the adult human female, deeply corrugated on the surface, and of a flattish oval figure. Many immature Graafian follicles were distinguished.[1]

FALLOPIAN TUBES.

The commencement of each Fallopian tube lies within a somewhat capacious pouch, which holds 3½ ounces of water when distended. The fimbriæ expand over the membranous walls of the pouch, and project as ridges from the inner surface. The outer surface is covered with peritoneum. Scattered muscular fibres (unstriped), together with vessels and nerves, lie in the membrane. The ovary lies, not in the fimbriated pouch itself, which directly communicates with the Fallopian tube, but in a separate compartment, lined with peritoneum, in whose wall the fimbriated pouch may be said to be excavated. A valve or membranous fold separates the two cavities. On the side of this valve, remote from that part of the pouch which ordinarily lodges the ovary, the Fallopian tube may be seen, expanding to its orifice. In the opposite direction it rapidly contracts to a long, narrow, and tortuous canal, which suddenly expands again to an outside diameter of about half an inch. From this point each of the cornua uteri converges towards its fellow, running parallel therewith for the last 3 inches of its course, and opening finally into the common uterus. The total length of each is about 14 inches. A number of uterine glands are visible towards the lower end of the cornua.

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[1] Mayer describes the outer surface as smooth "and only provided with lobes (Läppchen) at its point of attachment." He says, further, that there are no projecting Graafian follicles.

UTERUS.

The cornua unite to form a short tube of about an inch in length and three quarters of an inch in diameter. This leads into a somewhat larger chamber about three inches long, which represents the cervix uteri. The wall of the uterus is provided with circular muscular fibres. Outwardly the uterus is with difficulty distinguished from the vagina, but on opening the tube loose longitudinal folds of the mucous surface are found to converge towards two well-marked (anterior and posterior) internal protuberances, which nearly close the passage from one to the other, forming thus a kind of os uteri.

Dr Watson finds no constriction corresponding to an os uteri in the female of *Hyæna crocuta,* and goes on to say:—"The same remark holds good, so far as I can ascertain, of only one other placental mammal—that is, of the Indian elephant, in the female of which, as Mayer pointed out, the vagina is altogether absent, and the uterus opens directly into the urino-genital canal."[1] Mayer does not actually use this language, for he regards the uro-genital canal as vagina ("die mit der Urethra vereinte Vagina"), but the facts as described by him admit of Dr Watson's interpretation. Whether the uterus is really perfectly continuous with the vagina is another question, and here we must remark that we find much discrepancy between

[1] *Proc. Zool. Soc.* 1878, p. 424.

Mayer's account and the actual part which is now before us. Shortly below the union of the Fallopian tubes, there is visible externally a slight constriction. At the same point two considerable and well-marked enlargements project inwards from the internal wall and almost close the passage. Above this point the uterine wall is more distinctly and closely plicate than below. Hence the united Müllerian ducts appear to us to be plainly divisible (above the uro-genital canal) into two parts, which are separated by a constriction and differ in internal structure. The upper part seems to us to represent the uterus, and the lower the vagina, while the internal thickening may well represent an os uteri. It would be interesting to know something of the gravid uterus of the elephant, and in particular to ascertain by direct observation in what part of the united sexual ducts the fœtus is lodged, but we have no observations before us which bear upon this point.

VAGINA.

The next division of the generative canal may be distinguished as the vagina. It is about 9 inches long, and tapers upwards. The walls are almost entirely destitute of muscular fibres. On its inner surface a number of small and irregular rugæ are seen, some of which converge to an indistinct anterior and a posterior raphe.

URO-GENITAL CANAL.

Close to the entrance of the urethra into the generative duct a marked constriction is externally visible, and here, when the peritoneum is removed, the outer surface, which was smooth and membranous in the region of the vagina, becomes strongly marked by circular muscular fibres. On opening the tube a narrow passage serves as the only communication between the proper vagina and the vulva, or uro-genital canal. This passage is divided into lateral halves by a thick rounded cord covered by mucous membrane, which is apparently a hymen.[1]

The uro-genital canal is more than twice as long as the proper vagina, and when freed by dissection and extended, it projects 14 or 15 inches beyond the anus. In the natural (unexcited) state the tube is curved forwards and opens on the under surface of the belly, but by distention of the crura clitoridis it can be so far straightened that the orifice looks almost directly backwards, being then beneath the anus, but separated from it by a considerable interval. Thus the urine is ordinarily discharged downwards and forwards, but sexual congress takes place in something like the position ordinary among quadrupeds.[1]

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[1] It would be well to ascertain, when an opportunity occurs, whether this band is ruptured by copulation or parturition, as the descriptions of Hunter and Mayer indirectly lead us to suppose probable.

In the upper half of the uro-genital canal, above the root of the clitoris, its walls are invested by nearly circular muscular fibres, which are less distinct on the side adjacent to the rectum, and are also less developed in the lower part of this space. A strong band of muscular fibres is attached for about 2 inches to the body of the clitoris, near its root, and extends upon the sides of the uro-genital canal. These fibres diverge considerably, the lower ones passing nearly transversely, while the upper ones pass upwards and forwards at an angle of about 45°. They terminate along a defined line on the intestinal side, so that the muscles of opposite sides are separated by a clear membranous space of about 2½ inches. Some of the higher fibres are continued over the side of the rectum, and become continuous with the anterior fibres of the *sphincter ani*, while a number of more scattered fibres proceed from the upper part of the uro-genital canal, and are lost upon the sides of the rectum. The last nine inches of the canal have the walls thin and comparatively membranous, but muscular fibres can be still detected, which are attached to the sides of the clitoris and surround the tube.

When the uro-genital canal is laid open, its inner surface is seen to be lined by a smooth mucous membrane. An interrupted line of dark spots is visible near the external outlet, running about an inch apart from the defined line which marks the junction of the epidermic and epithelial surfaces. Two sinuses (canals of Malpighi?) open on the superior (intestinal) wall of the canal about the middle of its course, and can be traced for about 2 inches upwards. They open towards the outlet of the uro-genital canal. No glandular bodies were discovered in connection with the sinuses. The orifice of the urethra is a simple rounded opening on the side remote from the rectum.[1]

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[1] Dr Watson informs us that the evidence of eye-witnesses, though not so ample or explicit as might be desired, goes to show that the female rests upon the fore-knees with the hind legs extended in the standing posture.

The uro-genital outlet is not situated near the anus, but is ordinarily drawn forward, so as to reach the symphysis pubis. Its sides are very loose and do not appear to be provided with a distinct sphincter. The labia, or loose folds covered with mucous membrane, form a hood or prepuce to the prominent glans clitoridis.

CLITORIS.

In our specimen the clitoris measured 14 inches, and the glans projected nearly 2 inches. The two diverging crura spring from the rami of the os pubis. Beyond this junction the clitoris is nearly cylindrical. The vessels and large nerve lie on either side, while in the middle line, enclosed in a distinct membranous sheath, is the common tendon of the *retractores clitoridis.* These consist of a pair of small tapering muscles, which unite about 5 inches below their origin in a common tendon. This passes along the dorsum of the clitoris, and is inserted into the glans. The cavernous structure of the crura clitoridis is well marked, and they can be easily inflated. The glans is terminal and semi-globular.

ACCESSORY REPRODUCTIVE ORGANS.

The mammæ are pectoral, and two in number. They lie between the fore-legs. The two glands are contiguous, and the nipples are nearly intermediate between the middle line of the thorax and the axilla.

A temporal gland, situated above the zygoma, and half-way between the eye and the ear, may be possibly an accessory reproductive organ. It is flat, and in our example of squarish outline. It lies upon the temporal muscle, from which, however, it is separated by the temporal venous plexus. The excretory duct is short and of very small calibre, opening from the lower end of the gland. In the male and during the rutting season, a copious flow of odorous liquid is said to be discharged from the orifice. Our example was an immature female, but the gland was nevertheless well developed and conspicuous. It measured 3½ inches by 3 inches, and weighed about two ounces.

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[1] Hunter (*Essays and Observations*, vol. ii. p. 175), says that "at the termination of the proper vagina its cavity contracts at once, almost into a blind end; in the centre of which there are three small openings, neither of them larger than a crow-quill; the two lateral of these lead to two small sacs which pass a little way along the sides of the common vagina."

URINARY ORGANS.

Each kidney showed five lobes in our example, but other dissectors report various numbers, from two to eight or nine. The lobes were essentially distinct, each having its own cortical and medullary substance and a separate calyx, but the external separation was not very marked. Two or three Malpighian pyramids, hardly projecting into the calices, were found in each lobe; on the flattened apex of each the renal tubes were distinguished by the eye. The calices of the three anterior lobes united to form a common canal, which after a course of about 3 inches was joined by a similar tube formed by the union of the two posterior calices. Here the ureter was much dilated; it tapered towards the bladder for the first 4 inches of its course, and then continued with a nearly uniform diameter to near its termination, where it suddenly narrowed. The whole length was 18 inches.

The supra-renal capsules were transversely elongate, tapering to a point on the outer side.

Comparison of different descriptions of the elephant's kidney reveals much discrepancy as to the number and distinctness of the lobes, the number of calices and their mode of entry into the ureter. The unlikeness of Camper's figure to our dissection is extreme.

The bladder presents no remarkable features. The orifices of the ureters were seven-eighths of an inch apart[1] (in our young elephant), and the orifice of the urethra was about two inches distant from them. The ureters lie for about an inch between the coats of the bladder. In the young female the urethra is about an inch long, opening on the front of the uro-genital canal close to the proper vagina.

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[1] In Dr Watson's example the two ureters were separated by a distance of 3½ inches, and lay for 2¾ inches in the wall of the bladder.

HEART AND VESSELS.[1]

HEART.

The heart of the elephant has been repeatedly dissected, and may now be treated briefly. For fuller particulars the reader may consult Vulpian and Philipeaux,[2] together with the corrections and additions of Dr Morrison Watson.

The pericardium is pointed forwards, where it is united to the base of the heart. Two fibrous cords pass from the back of the pericardium to the tendinous centre of the diaphragm. Dr Watson finds them specially connected with the anterior of two plates of yellow elastic tissue which cover the two surfaces of the muscular portion of the diaphragm. He observes further "that the pericardiac band of the right side was entirely composed of that peculiar form of yellow elastic tissue which, so far as I am aware, has only once before been described, and that in the ligamentum nuchæ of the giraffe by Mr Quekett. In the left band, as well as in the plate into which the bands expanded, the elastic tissue presented the usual appearance." Vulpian and Philipeaux speak of the fibrous band as single.

The base of the heart is depressed forward, and the interventricular septum is nearly vertical and longitudinal. In the following remarks we shall use terms of direction and position with reference to the natural state of the parts. The base is understood to be anterior, the apex posterior, and the right auricle dorsal or superior.

With respect to the general form of the heart, the separation of the apices of the ventricles is the most important feature.[3] Vulpian and Philipeaux say: "Il n'y a pas de sillon inférieur inter-ventriculaire nettement dessiné. Il y a, au contraire, un sillon supérieur très profond, qui, du milieu de la base du cœur, se porte au voisinage de la pointe." In our example the case was almost reversed; the superior groove was shallow and unimportant, whereas the apical interventricular groove was deep and conspicuous. The right side of the heart is, so to speak, rotated upon the centre of the left; the right auricle being thrown to the dorsal surface of the heart, while the principal axis of the right side, passing directly through the auriculo-ventricular orifice, is inclined upwards, instead of lying nearly horizontal, as does that of the left side in the animal as it stands. The inferior face (anterior of man) gives no indication of this tilting of the right side, except that the right auricle is displaced; the two ventricles meet along a straight line and divide the lower surface nearly equally. Vulpian and Philipeaux found much fat at the base and on the front of the ventricles—the only instance we can recollect in which any considerable quantity of this substance has been met with in any part of the elephant. The heart dissected by us was perfectly destitute of fat.

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[1] It was our first intention (*supra*, p. 8) to omit the heart, lungs, and liver, seeing that Messrs Vulpian and Philipeaux have described them so minutely, but on comparing their account with our dissection, and with Dr Watson's notes, we find not a few discrepancies of greater or less importance. A short notice of these viscera is therefore included in the present memoir.

[2] *Ann. Sci. Nat. Zool.* 4e sér. tom. v. p. 183 (1856).

[3] In some Cetacea the apex of the heart is indented, while in Sirenia, particularly in the dugong, the separation of the ventricles is even more marked than in the elephant.

Right Auricle.—The walls are thin, but strengthened by pectinated muscles above, as well as in the appendix, which is hardly separable from the general cavity. Vulpian and Philipeaux describe the wall as areolated towards the venæ cavæ, but this was not the case in our example, except behind the left anterior cava. Two anterior venæ cavæ (right and left) enter, one towards the base, the other towards the apical end, and a posterior vena cava on the dorsal and external side, somewhat in front of the left anterior cava. A sigmoid valve passes from the external side of the right anterior cava, adjacent to the appendix, curves round the ventral side of the orifice, and is then continued as a long membranous ridge of slight projection to the basal or anterior side of the posterior cava; it then crosses that opening on its ventral margin, becoming somewhat more prominent, and serving as a proper valve to the posterior cava; finally, it gradually disappears along the base of attachment of the Eustachian valve. This agrees tolerably well with the description of Vulpian and Philipeaux; and with Dr Watson's figure, though in the text of his description he says that the valve passed round the *upper* margin of the right anterior cava. A large Eustachian valve separates the posterior from the left anterior cava. The great coronary vein opens into the left anterior cava under cover of a pectinated muscle.

The two superior venæ cavæ in the elephant, as in monotremata, marsupials, many rodents, the hedgehog, and the bat, and by a rare deviation from the ordinary rule in the human subject also, are explicable as a retention of an embryonic structure very general in vertebrates. At first the blood is returned to the heart by an anterior (jugular) and a posterior (cardinal) pair of venous trunks, as well as by a median posterior, which persists and constitutes the inferior cava. The cardinal and jugular veins of each side unite to form a precaval or canal of Cuvier, and the two precavals are primitively united into a common trunk which enters the undivided auricle. The common precaval trunk ultimately forms part of the right auricle into which the two precavals then open separately, forming the right and left superior (or anterior) venæ cavæ. A transverse connection is next established between the jugular veins; the left jugular, below the transverse branch, and the left precaval contract and become obliterated; while the enlarged transverse branch becomes the left innominate vein, and the lower part of the right jugular together with the right precaval forms the single superior (or anterior) vena cava of the higher mammalia. The coronary sinus is, according to Mr Marshall, the only part of the left anterior cava which in these mammals remains pervious. (See Rathke, *Meckel's Archiv.* 1830, p. 63; and *Ueber den Bau und die Entwickelung des Venensystems der Wirbelthiere*, Königsberg, 1838; Bardeleben, *Müller's Archiv.* 1848; Marshall, *Phil. Trans.* 1850, part i.; and Owen, *Anatomy of Vertebrates*, vol. iii. p. 551.)

Right Ventricle.—The "incomplete septum" of Vulpian and Philipeaux seems to consist merely of the more or less united fleshy columns. In our example these differ considerably from the description of the authors just named. Four or five are attached, low down, to the external wall; three or four others, less distinct, from the ventricular wall to the interventricular septum. All the very numerous tendinous cords spring from fleshy columns, though these have not on the inner side of the ventricle any considerable free extent. No corpora Arantii are present on the semilunar valves of the pulmonary artery. The wall of the ventricle is cavernous towards the tricuspid valve, and also along a line leading from the apex to the orifice of the pulmonary artery, close to the ventral border of the interventricular septum. The tricuspid valve may have one or two (in our example two) small additional cusps.

Left Auricle.—The entry of the pulmonary veins seems to vary. Vulpian and Philipeaux found two openings into the auricle—a small internal and a large external, which latter received three of the pulmonary veins. Dr Watson describes four separate openings. In our dissection there was a large central orifice and a smaller one on each side—one internal and the other external; but the external vein was not altogether clear of the central one. A thin ridge upon the internal surface of the auricle separates the central from the internal orifice. The veins enter a thin and membranous sinus, which is slightly separated from the rest of the auricle by a prominent fleshy ridge. Part of the edge of this ridge forms the "valvular structure" noted by Dr Watson. The wall of the left auricle is strengthened, especially on the anterior and external sides, by numerous trabeculæ. The fossa ovalis is distinguishable only by a slight transparency.

Left Ventricle:—The mitral valve forms a continuous membranous ring, but indications of a separation into internal and external cusps are visible. Vulpian and Philipeaux found only two fleshy columns in the left ventricle—one above and the other below. We can distinguish four or more, all nearly on the same level, but divisible into an internal and external set. The aortic valves are continuous with the inner mitral.

Coronary Vessels.—Camper was probably mistaken in saying that there is only one coronary artery. Like several previous observers, we find two. The great coronary vein opens into the left anterior cava.

Pulmonary Artery.—Three dilatations, corresponding to the sinuses of Valsalva, are distinctly visible externally. The artery passes forwards, upwards, and to the left, curving round the aorta and dividing in the concavity of the aortic arch into two branches, one to each lung. The nearly obliterated ductus arteriosus passes obliquely from right to left, from the pulmonary artery shortly before it divides to the aorta, which it enters immediately to the left of the left subclavian artery.

Aorta.—The arch of the aorta gives off a very short innominate trunk, which subdivides into the right subclavian and the two carotids, and secondly, a left subclavian.[1] An *arteria thyroidea ima* proceeds from the point of separation of the two carotids.

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[1] Cuvier and Mayer seem to have found three trunks, viz., right subclavian, carotid, and left subclavian. Hunter, Owen, Vulpian and Philipeaux, and Watson agree with the statement in the text.

We have traced the arteries throughout the body, but the details of distribution offer few significant features.

Anterior Venæ Cavæ.—Dr Watson observes that "each was formed by the junction of *three* large trunks a short distance in front of the arch of the subclavian artery. Of these, one came from the outside, a second came from the direction of the middle line, whilst an intermediate one passed directly backwards. The vena cava of each side, thus formed, passed directly backwards, receiving in its course several smaller veins, one of which was the trunk formed by the union of the companion veins of the mammary artery, and finally opened into the right auricle. In addition to these, the right anterior cava received the azygos vein immediately before piercing the pericardium. There was no trace of a small or left azygos vein: the posterior cava, immediately after piercing the diaphragm, opened into the auricle."

VEINS AND VENOUS PLEXUSES.

The most striking peculiarity of the veins lies in the plexuses and free anastomoses which occur in nearly all sheltered parts of the body. We find extensive plexuses in the superficial and deep temporal, pharyngeal, pectoral, anterior and internal femoral, popliteal, axillary, and brachial regions, besides less important communications elsewhere. The veins are in general large and capacious. In some cases, at least, valves are wanting in the plexuses, but we were unable to test the freedom of communication in different directions by a general venous injection.

Superficial Temporal Plexus.—This lies above the zygoma and behind the eye, beneath the temporal gland and superficial to the temporal muscle. Its communications are with the temporal vein by means of a superficial branch which crosses the posterior end of the zygoma, with the internal maxillary and facial veins, and with the deep temporal plexus. The temporal artery crosses the zygoma immediately behind the vein noticed above, and gives branches, which do not inosculate, to the area of the venous plexus.[1]

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[1] Neugebaur has described a temporal venous plexus in the goose (*Nova Acta*, vol. xxi. p. 521. 1845). In Froriep's *Notizen*, Oct. 1832, p. 39, Otto has de-

Deep Temporal Plexus.—On reflecting the *temporalis* muscle, a large and intricate venous plexus is seen. The largest of the contributory veins cross the temporal fossa longitudinally under cover of the zygoma, and communicate in front with the interorbital veins. Two considerable branches pass in front of the neck of the lower jaw to communicate with the superficial temporal plexus, as also do some smaller branches at the anterior border of the *temporalis.*

Pterygoid Plexuses.—There is a complicated network of veins overlying the *pterygoideus externus,* and communicating (1) with the longitudinal veins of the deep temporal plexus; (2) with the internal maxillary vein; and (3) with the superficial temporal plexus, by means of the veins passing in front of the neck of the lower jaw.

When the *pterygoideus externus* is reflected, a free anastomosis of large veins is found, which receives branches from (1) superficial temporal; (2) deep temporal; (3) superficial pterygoid plexuses; (4) inferior dental veins; (5) venæ comites of meningeal artery. The plexus discharges into the internal jugular vein by four large trunks.

Pharyngeal Plexus.—This lies at the back of the mouth, and has been noticed in the description of the pharynx. On each side it receives muscular and vertebral veins; the internal jugular, with lingual, muscular, and facial branches; the internal maxillary; and a descending palatine vein. A single transverse branch connects the plexuses of the two sides.

Pectoral Plexus.—Beneath the *pectoralis* is a plexus of great extent and intricate arrangement, which effects communications with the intercostal, internal jugular, axillary, and internal mammary veins.

These particulars will probably suffice respecting vascular arrangements whose physiological interpretation is as yet so obscure. The plexuses of the extremities lie usually in the hollows of joints, and are both numerous, intricate, and capacious. Our notes and drawings preserve many details which it is not thought needful to describe in print.

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scribed the superficial temporal plexus of the elephant as *arterial,* an error corrected by Dr Watson. The same mistake is repeated in Owen's *Anatomy of Vertebrates,* vol. iii. p. 548.

Van der Kolk and Vrolik,[1] Hyrtl,[2] and others[3] have collected many examples of vascular plexuses in vertebrate animals, and have suggested several possible theories of their physiological effect. It seems necessary to distinguish and classify before any explanation is attempted, for no single explanation can possibly apply to all the recorded cases. Arterial and venous plexuses must be carefully separated, though this has not always been attended to. With respect to the arrangement of their component vessels, some plexuses arise by the breaking up of a trunk into many small branches, which subsequently reunite, and may be compared to a rope untwisted in the middle (*funiform* plexuses). Others form a network of communication between different vessels (*retiform* plexuses). Others, again, are due to the sudden breaking-up of an artery into many small branches, which may anastomose, but do not reunite; or to the entry of many small veins into a common trunk at or near the same place (*distributive* plexuses).

Such plexuses as we have seen in the elephant are all venous and retiform. We have no confident opinion respecting their physiological meaning. It may be worth while to remark that they are so extensive as to constitute in the aggregate a not inconsiderable reservoir of blood, which may remain nearly motionless, or move sluggishly when the animal is at rest, but must be impelled towards the heart by energetic contractions of the adjacent muscles. The small development of the lymphatic system is also an important, and not impossibly a related fact. The lymphatic glands are few and small, and the thoracic duct was not, in our example, materially larger than in an adult man. That the venous blood lodged in these many plexuses may have an absorbent office is a possible view, but one upon which we do not venture to lay emphasis.

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[1] "Recherches sur les plexus vasculaires chez différents animaux," Zool. Soc. of Amsterdam, transl. in *Ann. Sci. Nat. Zool.* 4e sér. tom. v. p. 111 (1856).

[2] "Neue Wundernetze und Geflechte bei Vögeln und Säugethieren," *Kais. Akad. d. Wiss. Math. naturw.* Bd. xxii. (1863). Also reprinted separately, 1864.

[3] Müller, Von Baer, Carlisle, Breschet, Milne Edwards, Turner, Murie, &c.

RESPIRATORY SYSTEM.

LARYNX.

The thyroid consists of two rhomboidal alæ, whose superior and inferior borders respectively converge forwards to the middle line at an obtuse angle. They are continuous in front for the upper half of their depth, and strongly connected by yellow elastic tissue in the lower half. The cornua project very slightly. To the postero-superior angle the cartilaginous tip of the thyro-hyal is articulated by a capsule lined with synovial membrane; the postero-inferior angle is similarly connected with the prominent lateral facet of the cricoid cartilage. The cricoid and arytænoid cartilages differ in no material respect from the same parts in man. Professor Owen observes that "the cricoid extends posteriorly over the first three tracheal rings."[1] This is not the case; the three upper rings of the trachea are obliquely cut off behind, and their edges are connected with the lower border of the cricoid. The epiglottis is very thin and flexible.

The *crico-thyroidei* are closely united in the middle line (C. and L.—261, fig. 2, z^1). *Crico-arytænoideus posticus* passes vertically to the base of the arytænoid cartilage, and the muscles of opposite sides blend. There is no *cerato-cricoideus*. *Arytænoideus* consists of a single set of fibres, which converge from each side to a transverse median tendon. The upper fibres are continuous with *thyro-arytænoideus*, so that the two muscles form a complete ring round the larynx. *Crico-arytænoideus* springs from the upper half and edge of the side of the cricoid cartilage; it is almost continuous with *thyro-arytænoideus* towards its insertion. *Thyro-arytænoideus* arises from the whole depth of the thyroid cartilage in the middle line, including the elastic tissue which closes the inferior vertical notch. The fibres pass downwards and backwards, to be inserted into the outer and posterior surfaces of the arytænoid cartilages. The muscle is continuous behind with the upper fibres of *arytænoideus*. No depressor of the epiglottis was made out. *Hyo-epiglottideus* (elevator of the epiglottis) is a strong muscle arising close to its fellow, from which it is separated by a septum of yellow elastic tissue. It springs from the basi-hyoid close to the middle line, and passes directly backwards to the anterior surface of the epiglottis, having a length of about three inches. The two muscles underlie the thyro-hyoid membrane and support this part of the floor of the pharyngeal pouch. Camper's drawing (pl. xii. fig. 4) is fairly correct, except that he does not indicate any separation of the muscles of opposite sides.

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[1] *Anat. of Vertebrates*, vol. iii. p. 591.

The upper or false vocal cord is rounded and hardly apparent except behind. The lower is straight and well-defined, with a sharp vibratile edge. A small laryngeal pouch leads backwards from the ventricle, and extends for a short distance under cover of the antero-external border of the arytænoid cartilage.

The superior laryngeal nerve pierces the anterior border of the thyroid cartilage near its centre.

Below the arytænoid cartilages and vocal cords the internal surface of the larynx is covered with longitudinally wrinkled yellow elastic tissue similar to that of the trachea. The mucous membrane above the vocal cords resembles that of the pharynx.

TRACHEA.

The trachea consists of about thirty rings. These are incomplete behind, and occasionally subdivided, the joints being enclosed in synovial capsules. The tube is lined by yellow elastic tissue thrown into firm and very narrow longitudinal folds. The space between the ends of the rings behind is occupied by two distinct layers of unstriped muscle, the outer layer being transverse and the inner vertical in the central part, but radiating outwards laterally.

BRONCHI.

"The right bronchus consisted of eight, the left of six rings. In addition to these, however, there were several cartilaginous nodules of small size representing rudimentary rings. No accessory bronchus, such as is so common among the ruminants, was met with, the azygos lobe of the right lung receiving its air-tube from the right bronchus after it had entered the substance of the lung."—(*Watson.*)

Lungs.

The shape of the lungs is adapted to the deep and narrow thorax; the whole of the ventral surface is in contact with the diaphragm, which extends forwards to the second or third rib. The visceral and parietal layers of the pleura are closely connected together by matted elastic tissue, while the pleural sac is at the same time pretty generally adherent to the thoracic wall on the one hand and to the surface of the lungs on the other. The right lung, according to Vulpian and Philipeaux, has a small upper lobe, a triangular internal lobe, which rises towards the trachea, and a very considerable third lobe. Dr Watson found only two lobes, of which the smaller lay on the left side and projected transversely from the lung immediately below the hilum. In our example the arrangement was nearly the same. The left lung is undivided. The lobules are very easily separable. Dr Watson observes that the bronchi branch irregularly, and that upon entering the lung they immediately lose the cartilaginous laminæ. This was the case in our subject also.

NERVOUS SYSTEM.

We are not able to give any useful information respecting the nervous system of the elephant. The brain was not removed until eight months after death, when its internal structure was much broken down. We have traced the chief nerves, but find no peculiarities sufficiently remarkable to justify a minute description.[1]

ORGANS OF SPECIAL SENSE.

Eye.

Mayer describes a special depressor of the lower eyelid, and Dr Watson confirms the statement. It arises with the *recti* and *obliqui* from the bony canal posterior to the orbit, and passes forwards beneath the eyeball to be inserted into the cartilage of the lower lid. Dr Watson notices also "a very extensive and well-developed periosteal muscle," which "corresponds exactly in position to the similar muscle in the sheep and deer."[1] The muscles which pass from the upper and lower eyelids to be inserted into the third eyelid are not, according to Dr Watson, distinct muscles at all, but fibres of the *orbicularis palpebrarum.*

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[1] For the relative sizes of the cranial nerves, Dr Harrison's description may be consulted. Quoted (with figure) in Sir J. Emerson Tennent's *Natural History of Ceylon*, p. 95.

Camper, Harrison, and Watson agree in stating that no true lachrymal apparatus is present. The Harderian gland lies between the inner wall of the orbit and the *rectus internus;* its excretory duct opens on the surface of the third eyelid.

EAR.

The membrana tympani is of oval form, and looks downwards, outwards, and a little forwards. The malleus is attached above the centre to the apex of the shallow funnel, which, as in other mammalia, projects inwards from the tympanic membrane. The apex of the funnel is directed upwards and forwards. In our young example the long diameter of the membrane was $\frac{7}{8}$ inch, and the short diameter $\frac{1}{8}$ inch less. Sir Everard Home gives $\frac{17}{20}$ inch as one dimension, and rather more than an inch as the other.[2] This was probably from an adult animal. The middle layer contains the usual radiating and circular fibres. No peculiarity of importance was observed with respect to the ossicles.

NOSE.

The cartilaginous nasal septum continues forwards the plane of the vomer and of the perpendicular plate of the ethmoid. It ends in front by a tapering projection which extends in advance of the bony nares, and supports the alinasal cartilages. The cartilage of the septum is not prolonged into the fibrous and muscular septum of the proboscis. Its upper edge gives origin to a set of longitudinal muscular fibres, which increase in number below, and ultimately blend with the under surface of *levator proboscidis.* The same edge gives off on each side a narrow lateral process, continuous along the whole length of the septum, and to these processes the alinasal cartilages are attached in front of the bony nares by a simple hinge-joint, without synovial capsule. In our young example each alinasal cartilage measures four inches in length and less than one inch in width; it has a slight curvature forwards and outwards. Its external margin is connected with the bony nares beneath *levator proboscidis* by a thin, tough, and extensive sheet of fibrous membrane, which can be traced downwards into the lining of the air-tubes of the proboscis. The membrane is capable of distension, and forms a kind of pouch, which greatly enlarges the capacity of the nares at this point. Transverse muscular fibres, continuing the series of the radiating fibres of the proboscis, connect the sides and under surface of this pouch with the margin of the bony nares. Another set of transverse fibres (*dilator naris*), extending across the alinasal cartilage and taking origin from it, passes to the adjacent border of the pouch, leaving a clear space about an inch in width between them and the lower transverse fibres. This upper set (*dilator naris*) would, when in action, tend to raise the free or external edge of alinasal cartilage, and thus increase the capacity of the pouch, while the lower transverse fibres would assist them to enlarge the pouch by drawing its sides outwards. The alinasal pouch is the only considerable chamber in the nose or trunk of the elephant; it may serve an important purpose in the storage of liquid. Behind the anterior bony nares we find a second lateral (aliseptal) cartilage. It is not perfectly continuous either with the nasal septum or the alinasal cartilage. It is connected with the former by a fibrous hinge-joint; with the latter by a strong elastic sheet, in which are a number of muscular fibres, which take origin from the upper border of the bony nares, and converge towards the fore end of the aliseptal cartilage. The position and form of this cartilage are those of a turbinated bone, but it is wholly unossified; its size is small in comparison with the relative development of the turbinated bones in most mammals. Its chief extension is in the direction of the nasal passage, and this dimension is about four inches in our specimen; the greatest vertical depth is two inches. The anterior half of the cartilage falls away outwards from the plane of the posterior half, so as to give rise to a decided step in the middle of the length. The general direction of the cartilage is vertical, but somewhat irregular, and the lower edge is rather nearer to the median plane (especially in its posterior half) than the upper. This aliseptal cartilage forms part of the outer wall of the nasal passage, as well as the inner wall of a transversely contracted channel which leads from the nasal meatus to a large frontal sinus. The muscular fibres attached to the fore edge of the aliseptal cartilage, which are continuous with the lower set of the transverse fibres of the alinasal pouch, when they contract, draw the cartilage towards the bony or outermost wall of the nasal chamber, and very effectually close the entrance into the air-sinus. The lower border of the cartilage, for somewhat more than the anterior half of its extent, is connected with the wall of the nasal chamber by a strong band of yellow elastic tissue, which forms part of the dividing septum between the proper respiratory passage and the entrance to the frontal air-sinus; it serves to antagonise the muscular fibres which close the valve. The posterior extremity of the cartilage is connected to the lateral wall by a mass of fibrous and mucous tissue, which forms the anterior boundary of the special respiratory chamber, and separates this from the channel leading to the frontal sinus. The aliethmoidal volutes are disposed in about seven laminæ, which gradually diminish in size backwards, and closely resemble the bony framework of the olfactory organ in the horse. Behind this point the nasal passage lies between the hard palate and the spheno-palatine surface. Its vertical extent in our young example is nearly three inches, but the transverse width is extremely small, and hence the nasal passages seen from behind present the appearance of greatly elongated vertical slits. (See p. 50.)

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[1] Described by Professor Turner in the *Proc. Royal Phys. Soc.* Edinburgh, Dec. 19, 1861, and *Nat. Hist. Review*, Jan. 1862.

[2] *Phil. Trans.* for 1800, p. 4.

Dr Watson believes that the valve-like aliseptal cartilage is adapted to obstruct the flow of water into the air-sinuses of the skull during its passage along the narial tubes. We are disposed to question the normal passage of water along this highly sensitive tract. Examination of the parts discovers no valve or other provision for preventing water flowing from behind forwards[1] from gaining free entrance into the olfactory recesses. Moreover, the only important receptacle above the stomach is constituted by the pouch adjacent to the alinasal cartilage. We are inclined to suppose that the water lodged here (if, as we see no reason to doubt, the pouch in question actually serves as a receptacle for liquid) is pumped up through the proboscis, and never passes backwards beyond the anterior bony nares. The water which, according to the testimony of many observers, is regurgitated from the stomach, would, we imagine, be withdrawn exclusively by the tip of the proboscis inserted through the mouth into the pharyngeal pouch.

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[1] See the quotation from Dr Watson's memoir on p. 54.

CONCLUDING REMARKS.

It may be worth while to direct the attention of future dissectors to certain points, which have been passed over or inadequately treated by us. Most of these are superficial or easily made out, and it is to be hoped that the first opportunity may be seized of correcting our notes.

1. The cutaneous muscles should be redissected and more fully described.

2. The sterno-humeral and superficial cervical muscles (*pectoralis, masto-humeralis, sterno-maxillaris, sterno-mastoideus*) were insufficiently noted by us and in the first hasty examination of the thorax, made before the possibility of a complete dissection was entertained, these muscles were mutilated beyond recovery. We have attempted to piece together and interpret the remaining shreds of muscle, but the results are not altogether trustworthy.

3. The large intestine should be studied microscopically while quite fresh.

4. The brain should be removed immediately after death, and minutely investigated. The parts liable to be injured in the process of extraction are now well known.

The difficulties attending the anatomical examination of a single example of a very large animal must be our excuse for many shortcomings. If we shall be found to have aided the next observer as much as Camper, Cuvier and Watson have aided us, we shall at least have repaid our debt. We do not doubt that much, very much, remains to be done before the structure of this single species is adequately made known. Minute and accurate knowledge of the anatomy of the elephant will be found of special value, and competent anatomists are happily not so few that we need grudge the time and labour which minute and accurate knowledge is sure to cost.

Postscript.

The foregoing memoir was originally contributed to the *Journal of Anatomy and Physiology*, where it appeared in January, April, and October 1878. A short notice of the male generative organs has since been added. In reprinting, the word "inaccurate" (p. 28 line 34) has been accidentally changed to "accurate."

EXPLANATION OF PLATES.

PLATE I.

Fig. 1. Inner side of right fore-limb.

h.	Humerus.
co.	Coracoid process.
ol.	Olecranon.
pct.	*Pectoralis.*
r.	Radius.
sm.	*Serratus magnus.*
sc.	*Sub-scapularis.*
sp.	*Supra-spinatus.*
tm.	*Teres major.*
bi.	*Biceps.*
cb.	*Coraco-brachialis.*
tr.	*Triceps.*
de.	*Dorso-epitrochlearis.*
ba.	*Brachialis anticus.*
ecr.	*Extensor carpi radialis longior.*
ep.	*Extensor proprius pollicis.*
fcr.	*Flexor carpi radialis.*
pl.	*Palmaris.*
fld.	*Flexor longus digitorum.*
pr.	*Pronator radii teres.*
br.	Brachial artery.

Fig. 2. Flexor side of left fore-arm.

u.	Ulna.
el.	Elastic ligament.
ecu.	*Extensor carpi ulnaris.*
fcu.	*Flexor carpi ulnaris.*[1]

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[1] This should pass in front of *flexor longus digitorum*, to be inserted into the pisiform bone at ×.

an.	*Anconæus.*
m.	See p. 15, line 5.
fp.	*Flexor longus pollicis.*
fbd.	*Flexor brevis digitorum.*
amd.	*Abductor minimi digiti.*
emd.	*Extensor minimi digiti.*
ra.	Radial artery.
un.	Ulnar nerve.
mn.	Median nerve.

Other references as in fig. 1.

⁂ Fig. 2 is drawn on a larger scale than fig. 1.

PLATE II.

Fig. 1. Dissection of the root of the proboscis. Side view.

lp.	*Levator proboscidis* (reflected).
dn.	*Dilator narium.*
an.	Alinasal cartilage.
tf.	Transverse muscular fibres of alinasal pouch.

Fig. 2. Front view.

PLATE III.

Section through nasal passages, pharynx, and larynx.

fs.	Frontal sinus.
cc.	Cranial cavity.
e.	Eustachian tube.
ph.p.	Pharyngeal pouch.
jc.	Jacobson's canal.
bs.	Basi-sphenoid.
mx.	Maxilla.
pmx.	Premaxilla.
mn.	Mandible.
hy.	Hyoid.
an.	Alinasal cartilage.
as.	Aliseptal cartilage.
ae.	Aliethmoidal volutes.
th.	Thyroid cartilage.
cr.	Cricoid cartilage.
cp.	Constrictor pharyngis.
s.	Hind edge of nasal septum.

⁂ The proportions, especially of the bony parts, will be found to differ from those of the adult elephant.

PLATE IV.

Fig. 1. Uro-genital organs (female). General view.

sr.	Supra-renal capsule.
k.	Kidney.

b. Bladder.
o. Ovary.
u. Uterus.
v. Vagina.
ug. Uro-genital canal.
cl. Clitoris.
r. Rectum.

Fig. 2. Ovary and commencement of Fallopian tube.

o. Ovary.

Fig. 3. Commencement of uro-genital canal (laid open).

h. Hymen?

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Plate I.

Fig. I.

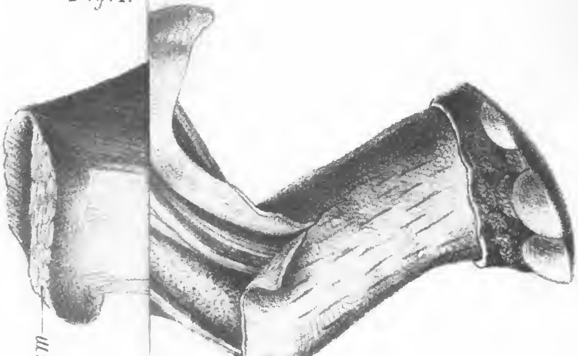

Fig. 2.

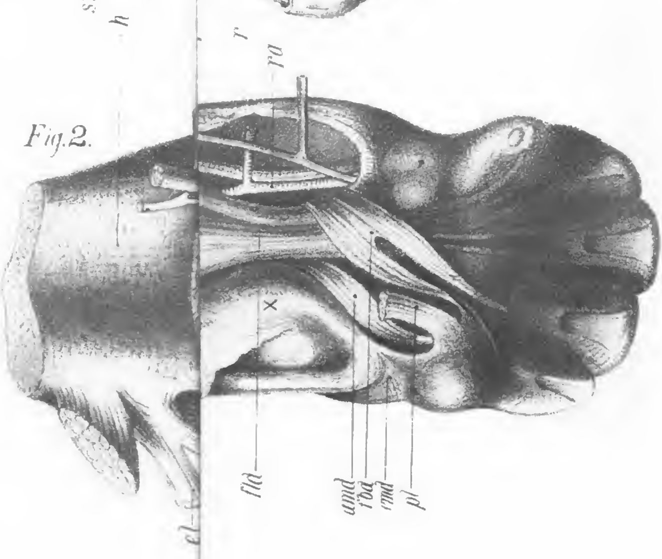

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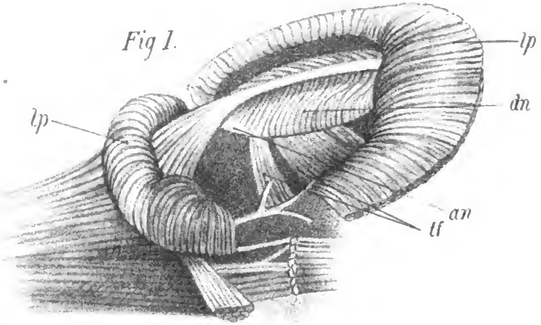
Plate II.

Fig 1.



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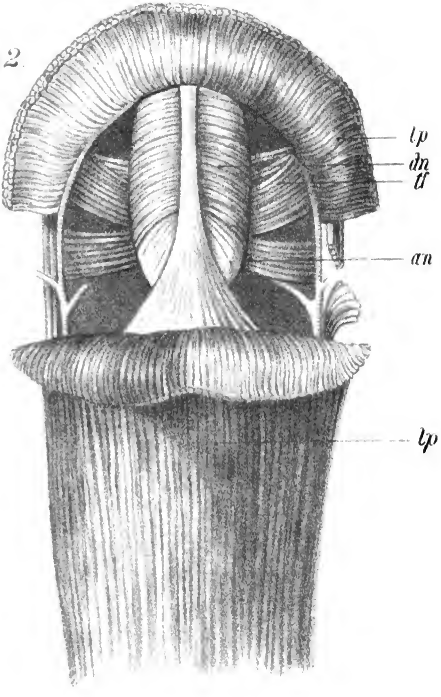

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Plate III

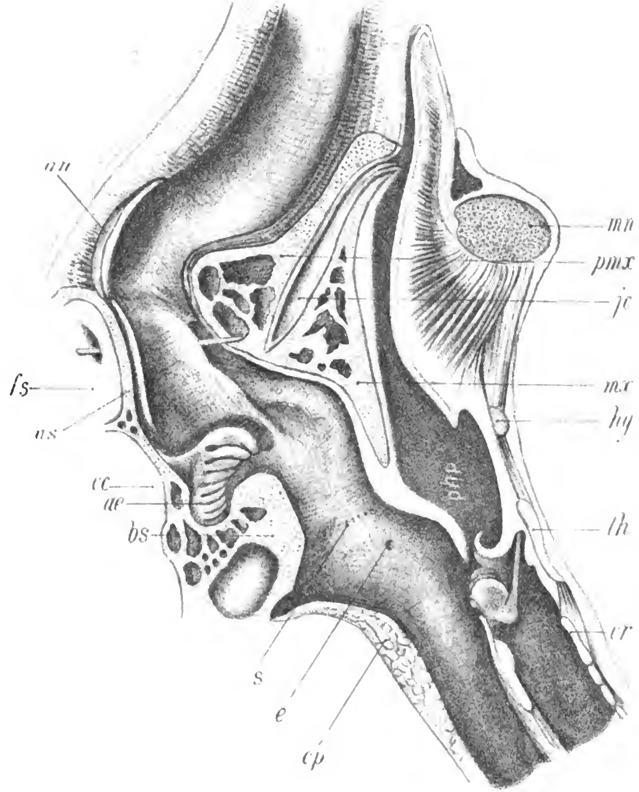

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Plate IV

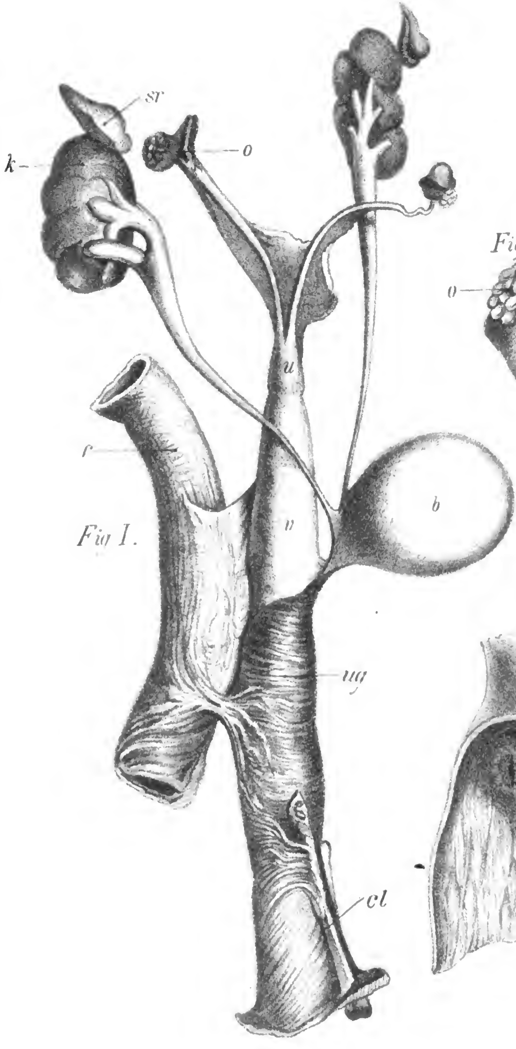
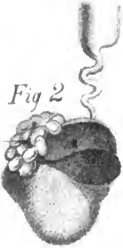


Fig 1.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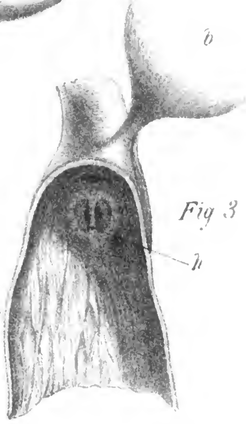
Fig 3

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